Quality Assurance Sampling and Analysis Plan

Site:
Riverside Avenue
29 Riverside Avenue
Newark, NJ 07104

Submitted to:
US EPA Region 2
2890 Woodbridge Avenue
Edison, NJ 08837

Prepared for:
US EPA Region 2
2890 Woodbridge Avenue
Edison, NJ 08837

Prepared by:
KEMRON Environmental Services, Inc.
1359-A Ellsworth Industrial Boulevard, N.W.
Atlanta, GA 30318

October 27, 2011

KEMRON Project No. SE1838

Client: US EPA Region 2
Project: Riverside Avenue
KEMRON Project No.: SE1838

This document has been reviewed for technical content and quality, clarity, and style in accordance with the internal QA/QC procedures of KEMRON.

Acknowledgements:

Technical Review:

____________________	T&D Coordinator	____________
Janelle Murphy	Title	Date

KEMRON Review:

K. Shaver	Response Manager	OCT 28 2011
Kevin Shaver	Title	Date

EPA Review:

____________________	U.S. EPA OSC	____________
Eric Daly	Title	Date

Table of Contents

Tables

Appendices

Distribution List

Eric Daly, USEPA, OSC
Kevin Shaver, KEMRON, Response Manager
Nestor Martinez, KEMRON, Chemist
Erica Pounds, KEMRON, Chemist
Janelle Murphy, KEMRON, T&D Coordinator

1.0 SITE BACKGROUND

This site is located in the City of Newark, which is in Essex County in the State of New Jersey. The nearest residence is within 500_ feet to the:

☐ *North*	☐ *South*	☒ *East*	☐ *West*
☐ *Northeast*	☐ *Southeast*	☐ *Northwest*	☐ *Southwest*

The site is a:

☐ *battery reclamation*	☐ *neighborhood*	☐ *wood preservation facility*
☒ *chemical manufacturing*	☐ *salvage yard*	☐ *solvent recovery*
☐ *drum recycling*	☐ *private residence*	☐ *tannery*
☐ *incinerator/smelter*	☐ *refinery*	☒ *warehouse*
☐ *landfill*	☐ *resource recovery*	☐ *waste facility*
☐ *metal plating*	☐ *retail gas station*	☐ other ______________

located on 2 acres which are:

☐ *still active*	☒ *now abandoned*	☐ *unknown*

It was abandoned in 2009. The following remedial units are present at the site:

☒ *buildings*	☐ *landfill*	☒ *surface water*
☐ *drainage ditch*	☐ *process area*	☒ *tank farm*
☒ *drums*	☐ *roads/access ways*	☐ *vats*
☐ *groundwater*	☒ *soil*	☐ *waste pile*
☐ *impoundment*	☐ *storage area*	☐ *wooded area*
☐ *laboratory*	☒ *storage tank*	☐ *other* ______________
☐ *lagoon*	☐ *stormwater pond*	

The following types of materials were handled at the site:

☐ *acids*	☐ *bases*	☐ *inorganics*	☒ *organics*
☒ *petroleum products*	☒ *solvents*	☐ *volatile organics*	☒ *unknown*

The contaminants of concern are:

Contaminant	Concentration Range
Asbestos	Unknown
Polychlorinated Biphenyls	Unknown
Flammables	Unknown
Corrosives	Unknown
Unknowns	Unknown

The volumes of contaminated materials to be addressed are:

☒ *pounds* ☒ *tons* ☒ *cubic yards* ☒ *rolloff*
☒ *5 gallon* ☒ *55 gallon* ☒ *85 gallon* ☒ *500 gallon*
☐ *other* ____________

The suspected contamination is a result of:

☐ *accident* ☐ *fire* ☐ *spill* ☐ *unknown*
☒ *improper waste and disposal*

The physical/chemical threat to the population is:

☐ *high* ☒ *moderate* ☐ *minimal*

The following sampling constraints have been identified:

☒ *there have not been any sampling constraints identified to date.*
☐ ____

The following additional information is known about the site:

Historical uses include varnish manufacturing, paint manufacturing, chemical storage.

The current stage/phase of the project is:

☐ *assessment* ☐ *emergency response* ☐ *remedial* ☒ *cleanup*
☐ *investigative* ☐ *other* ____________

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The United State Environmental Protection Agency (USEPA) On-Scene Coordinator (OSC)/Remedial Project Manager (RPM) will provide overall direction to the KEMRON staff concerning project objectives, sampling needs, and schedule.

The KEMRON Project Manager (PM)/Response Manager (RM) is the primary contact with the USEPA OSC/RPM. The PM/RM is responsible for the development and completion of the Quality Assurance Sampling and Analysis Plan (QASAP), project team organization, and supervision of all project tasks.

3.0 DATA QUALITY OBJECTIVE RATIONALE

Data quality objectives (DQOs) are qualitative and quantitative statements developed by data users to specify the quality of data from field and laboratory data collection activities to support specific decisions or regulatory actions. The DQOs describe what data are needed, why the data are needed, and how the data will be used to address the problem being investigated. DQOs also establish numeric limits for the data to allow the data user (or reviewers) to determine whether data collected are of sufficient quality for use in their intended application. Two types of data can be generated from the sampling objective: screening data and definitive data.

3.1 Screening Objectives

The objective of screening data is to afford one with a quick and preliminary assessment of the site contamination. This objective for data quality is available for data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This objective allows for the collection of the greatest amount of data with the least expenditure of time and money. The end user of the data should be aware that data collected for this objective have neither definitive identification of pollutants nor definitive quantitation of their concentration level.

Although there is no quality assurance data collected with this objective, a calibration or performance check of the method is required along with verification of the detection level. The screening objective does not preclude the adherence to prescribed quality control checks given in USEPA methods and standard operating procedures (SOPs) or the manufacturer's recommendations.

The screening objective is generally applied to but not limited to the following activities: physical and/or chemical properties of samples; extent and degree of contamination relative to concentration differences; delineation of pollutant plume in ground water (head space or soil gas analysis techniques); monitor well placement; waste compatibility; preliminary health and safety assessment; hazardous categorization; and preliminary identification and quantitation of pollutants.

3.2 Definitive Objective:

The definitive objective is used to assess the accuracy of the concentration level as well as the identity of the analyte(s) of interest from the analytical field or lab results. This quality objective is intended to give the decision-maker a level of confidence for a select group of critical samples so he/she can make a decision based on an action level with regard to treatment, disposal, site remediation and/or removal of pollutants, health risk or environmental impact, cleanup verification, pollutant source identification, delineation of contaminants, and other significant decisions where an action level is of concern.

Analyte-specific methods must be used for this quality objective. This objective is generally applied to (but not limited to) the following activities: physical and/or chemical properties of samples, extent and degree of contamination, verification of pollutant plume definition in groundwater, verification of human and safety assessment, verification of pollutant identification, and verification of cleanup.

The USEPA has requested KEMRON to complete the task as outlined in the delivery order. The DQO of this sampling event is to evaluate the potential health risks and environmental impacts, while determining the profile characteristics of the waste, for either off-site disposal or possible on-site stabilization.

Table 1 outlines the project-specific DQOs.

Table 1 Project-Specific Data Quality Objects

Data Quality Objective	Project-Specific Action
Problem statement	Historical activities at the site caused contamination, which posed a risk to human health. Evaluate the potential health risks and environmental impacts, while determining the profile characteristics of the waste, for either off-site disposal or possible on-site stabilization.
Identify the decisions	Evaluate the potential health risks and environmental impacts, while determining the profile characteristics of the waste, for either off-site disposal or possible on-site stabilization.
Identify inputs to the decision	Compare the analytical results to the hazardous waste characteristics to determine if the waste is hazardous or non-hazardous.
Define boundary of project	The work plan shows the boundaries of the site.
Develop the decision rule	If the material is hazardous it should be managed under Subtitle C. If the material is non-hazardous then it should be managed as a non-RCRA hazardous waste.
Specify limits on decision errors	A 95% confidence level is specified for this project.

3.3 General Description of DQOs

The usability of the data is matched to the DQOs. A number of factors relate to the quality of data and sample collection methods and are as important to consider as methods used for sample analysis. Following SOPs for both sample collection and analysis reduces sampling and analytical error. Complete chain-of-custody documentation, and adherence to required sample preservation techniques, holding times, and proper shipment methods ensure sample integrity. KEMRON employs trained, experienced technicians capable of all forms of sampling techniques. By utilizing trained personnel and following detailed site-specific sampling procedures, KEMRON will maintain the data quality at the site level. Obtaining valid and comparable data also requires adequate Quality Assurance/ Quality Control (QA/QC) procedures and documentation, as well as established detection and control limits.

"Valid data" is defined as results that are generated when the instrument and quality controls are within the designated limits. Data validation procedures are designed to systematically review data quality and to assign qualifiers that indicate limited usability of other data.

3.4 Measurement of Data Quality

KEMRON's QA objective is to ensure that environmental monitoring data of known and acceptable quality are collected to sufficiently characterize the hazardous and non-hazardous material for disposal, and to support cleanup actions at the site. To meet this goal, the following quality control parameters will be evaluated: precision, accuracy, representativeness, comparability, and completeness. These parameters will be evaluated by the laboratory during analyses and will be evaluated by KEMRON during the final data validation. The precision and accuracy criteria presented in Appendix A will be utilized for data validation if laboratory-generated precision and accuracy criteria are not available.

3.4.1 Precision

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed and similar conditions.

Precision of the measurement data for this project will be based upon duplicate analyses (replicability), control sample analyses (repeatability), and results for duplicate field samples (sample replicability). A field duplicate is defined as a sample that is divided into two equal parts for the purpose of analysis. Field duplicates will be collected for all sample matrices and analyzed for all parameters. Discretely sampled field duplicates are useful in determining sampling variability. However, greater than expected differences between duplicates may occur because of variability in the sample material. Field duplicates shall be used as a quality control measure to monitor precision relative to sample collection activities.

Analytical precision shall be evaluated by using matrix spike/matrix spike duplicates (MS/MSDs), laboratory control samples (LCSs) or by using sample duplicates. Precision is calculated in terms of relative percent difference (RPD). RPDs must be compared to the laboratory-established RPD for the analysis. Precision of duplicates may depend on sample homogeneity. The analyst or his/her supervisor must investigate the cause of data outside stated acceptance limits. Corrective action may include recalibration, re-analysis of QC samples, sample re-analysis, or flagging the data as suspect if problems cannot be resolved.

3.4.2 Accuracy

Accuracy is the degree of agreement of a measurement or average of measurements with an accepted reference or "true" value. Accuracy is a measure of bias in the system.

Accuracy of the measurement data will be assessed and controlled as follows. Results for blanks, matrix, laboratory control, and surrogate spikes will be the primary indicators of accuracy. These results will be used to control accuracy within acceptable limits by requiring that they meet specific criteria. As spiked samples are analyzed, spike recoveries will be calculated and compared to pre-established acceptance limits.

Acceptance limits will be based upon previously established laboratory capabilities for similar samples using control chart techniques. In this approach, the control limits reflect the minimum and maximum recoveries expected for individual measurements for an in-control system. Recoveries outside the established limits indicate some assignable cause, other than normal measurement error, and the need for corrective action. This includes recalibration of the instrument, re-analysis of the QC sample, re-analysis of the samples in the batch, or flagging the data as suspect if the problem cannot be resolved. Recovery of matrix spikes may depend on sample homogeneity.

3.4.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. The characteristics of representativeness are usually not quantifiable. Subjective factors to be taken into account are as follows:

- Degree of homogeneity of a site;
- Degree of homogeneity of a sample taken from one point in a site; and
- Available information on which a sampling plan is based.

Field duplicates, as defined under precision, are also used to assess representativeness. Two samples collected at the same location and at the same time are considered to be equally representative of this condition, at a given point in space and time. To maximize representativeness of results, sampling techniques, sample size, and sample locations will be carefully chosen to provide laboratory samples representative of the site and the specific area. For instance, soil samples are likely to be less homogeneous than liquid waste samples, and thus it is important for the sampler and analyst to follow SOPs when collecting soil samples. Samples exhibiting obvious stratification or lithologic changes should not be used as replicates. Within the laboratory, precautions are taken to extract from the sample container an aliquot representative of the whole sample. However, samples requiring analysis of volatile organic compounds (VOCs) should not be mixed.

3.4.4 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured through the use of established and approved sample collection techniques and analytical methods, consistency in the basis of analysis, consistency in reporting units, and analysis of standard reference materials.

The use of standard methods to collect and analyze samples, along with instruments calibrated against Standard Analytical Reference Materials (SARMs), which are National Institute for Standards and Technology (NIST) traceable standards, will also ensure comparability.

Comparability also depends on the other data quality characteristics. Only when data are judged to be representative of the environmental conditions, and when precision and accuracy are known, can data sets be compared with confidence.

3.4.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under controlled laboratory conditions.

Data completeness is a measure of the extent to which the database resulting from a measurement effort fulfills objectives for the amount of data required. Completeness is defined as the valid data percentage of the total tests requested.

Valid analyses are defined as those where the sample arrived at the laboratory intact, properly preserved, in sufficient quantity to perform the requested analyses, and accompanied by a completed chain-of-custody form. Furthermore, the sample must be analyzed within the specified holding time and in such a manner that analytical QC acceptance criteria are met.

3.5 Special Training Requirements/Certifications

Personnel assigned to the site, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. Each staff member will have the education, training, technical knowledge, and experience to perform assigned functions.

Training shall be provided, if needed, to achieve initial proficiency; maintain proficiency; and adapt to changes in technology, methods, or job responsibilities. Training will be documented on the appropriate form, and placed in the site file as a record.

Site personnel will receive an orientation to the appropriate work plans, including this QASAP, and the Health and Safety Plan (HASP), as appropriate to their responsibilities before participation in site activities. The KEMRON PM/RM or a qualified designee will provide training of field personnel. Training of laboratory personnel will be the responsibility of the subcontractor laboratory. Copies of personnel training and qualification records will be kept on file in the form of resumes and training and orientation records. Subcontractor records will be reviewed during audits. KEMRON records maintenance is the responsibility of the PM/RM.

The frequency of sample collection is outlined in Table 2 below.

Table 2 Field Sampling Summary

Analytical Parameters	Matrix	Subtotal Samples	Trip Blanks*	Field Blanks**	Equipment Blanks***	Duplicate Samples[1]	MS/MSD Samples[1]	Total Field Samples
VOA (8260B)	Oil, water, solids, solvents, unknowns	up to 30	1 per cooler	1 per day	1 per day	1 per 20	1per 20	up to 40
BNA (8270C)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
Pesticides (8081A)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
Herbicides (8151A)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
PCB (8082)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
TAL Metals (6010/7000)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
TCLP-VOA (1311/8260B)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
TCLP-BNA (1311/8270C)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
TCLP- Pesticides (1311/8081A)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
TCLP-Herbicides (1311/8151A)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
TOX (9060)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
Ignitability (1010)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
Reactivity (SW-846 Ch 7)	Oil, water, solids,	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40

Analytical Parameters	Matrix	Subtotal Samples	Trip Blanks*	Field Blanks**	Equipment Blanks***	Duplicate Samples[1]	MS/MSD Samples[1]	Total Field Samples
	solvents, unknowns							
TCLP-Total Metals plus Cu, Zn	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
Nitrates, Sulfate Chlorides, TSS, Fluorides, TS Phosphates	Water, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
Corrosivity (9040B)	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40
% Water	Oil, water, solids, solvents, unknowns	up to 30	NA	1 per day	1 per day	1 per 20	1 per 20	up to 40

Notes:
[1] Note required for QA-1 (screening)
* Trip blanks will be required for environmental samples but not for waste samples
** Field blanks will be performed at a rate of two per day, once per four-hour sampling period.
***Equipment blanks will be performed at a rate of two per day per piece of equipment that has been decontaminated. If dedicated equipment is utilized there will not be a need for a rinsate blank.

Table 3 Data Quality Objectives for Removal Activities

Sampling Objective	Data Type
☒ Emergency Response	Screening
☐ Emergency Response	Definitive
☒ Determine identification of contaminants	Screening
☐ Determine identification of contaminants	Definitive
☒ Extent of contamination	Screening
☐ Extent of contamination	Definitive
☒ Treatment and disposal options	Screening
☐ Treatment and disposal options	Definitive

Table 4 Data Quality Objectives for Site Assessment Activities

Sampling Objective	Data Type
☒ Treatment and disposal options	Screening
☐ Treatment and disposal options	Definitive
☐ Quantity of contamination	Screening
☐ Quantity of contamination	Definitive
☐ Determine identification of contaminants	Screening
☐ Determine identification of contaminants	Definitive

The required confidence level for definitive data is:

☐ 85% ☐ 90% ☒ 95%

Rational for confidence levels less that 95% is not acceptable.

4.0 SAMPLING DESIGN

The following waste streams will be sampled as indicated in Table 5.

Table 5 Contaminant Sources, Recommended Analysis, and Proposed Methods

Sample Source	Contaminant Sources	Recommended Analysis	Analytical Methods
☐ Recyclable Solvents	drums, tanks, containers	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		TCL Volatiles	8260B
		TCL Semivolatiles	8270C
		PCBs	8082
		TAL Metals	6010B/7000/7470
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		Density	SM213E
		Total Organic Halogens (TOX)	9020B
		% ASH	1209/D2974
		BTU	BTU- D240-76
		% Water	Karl Fischer
		Chlorine content	ASTM D808/EPA 300.0
		Bromine content	ASTM D808/EPA 300.0
		Iodine content	ASTM E442/D3869C
		Sulfur content	ASTM D4239
☐ Recyclable Feedstock	drums, tanks, containers	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TAL Metals	6010B/7000 /7470
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		Density	SM213E
		Total Organic Halogens	9020B
		% ASH	1209/D2974
		BTU	BTU- D240-76
		% Water	Karl Fischer
		Chlorine content	ASTM D808/EPA 300.0
		Bromine content	ASTM D808/EPA 300.0
		Iodine content	ASTM E442/D3869C
		Sulfur content	ASTM D4239
☒ Flammable Waste	drums, tanks, containers	Ignitability	1010
		Corrosivity pH	9040B

Sample Source	Contaminant Sources	Recommended Analysis	Analytical Methods
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TCL Volatiles	8260B
		TCL Semivolatiles	8270C
		TAL Metals	6010B/7000 /7470
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		Density	SM213E
		Total Organic Halogens (TOX)	9020B
		% ASH	1209/D2974
		BTU	BTU- D240-76
		% Water	Karl Fischer
		Chlorine content	ASTM D808/EPA 300.0
		Bromine content	ASTM D808/EPA 300.0
		Iodine content	ASTM E442/D3869C
		Sulfur content	ASTM D4239
☒ Combustible Waste i.e., diethylene glycol ethyl ether	drums, tanks, containers	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		TCL Volatiles	8260B
		TCL Semivolatiles	8270C
		PCBs	8082
		TAL Metals	6010B/7000/7470
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311//8151A
		TCLP Metals	1311/6010B/7000/7470
		Density	SM213E
		Total Organic Halogens	9020B
		% ASH	1209/D2974
		BTU	BTU- D240-76
		% Water	Karl Fischer
		Chlorine content	ASTM D808/EPA 300.0
		Bromine content	ASTM D808/EPA 300.0
		Iodine content	ASTM E442/D3869C
		Sulfur content	ASTM D4239
☒ Corrosive (Acidic)	drums, vats, tanks	Ignitability	1010
		Acidity	EPA 305
		Corrosivity toward steel	1110
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A

Sample Source	Contaminant Sources	Recommended Analysis	Analytical Methods
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		TAL Metals	6010B/7000/7470
		Density	SM213E
		Total Organic Halogens (TOX)	9020B
		Total Organic Carbon (TOC)	9060
		Chlorides	9056/9012/9253
		Fluorides	9056/9214
		Total Phosphorus	9056/EPA 365.2
		Sulfates	9056/9038
		Nitrates	9056
☒ Corrosive (Basic)	drums, vats, tanks	Ignitability	1010
		Alkalinity	EPA 310
		Corrosivity pH	9040B
		Corrosivity toward steel	1110
		PCBs	8082
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		TAL Metals	6010B/7000/7470
		Density	SM213E
		Total Organic Halogens (TOX)	9020B
		Total Organic Carbon (TOC)	9060
☐ Chlorinated Hydrocarbons i.e., dichloromethane, TCE, PCE	drums, vats, tanks	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		TCL Volatiles	8260B
		TCL Semivolatiles	8270C
		PCBs	8082
		TAL Metals	6010B/7000 /7470
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		Density	SM213E
		Total Organic Halogens (TOX)	9020B
		% ASH	1209/D2974
		BTU	BTU- D240-76
		% Water	Karl Fischer
		Chlorine content	ASTM D808/EPA 300.0
		Bromine content	ASTM D808/EPA 300.0
		Iodine content	ASTM E442/D3869C
		Sulfur content	ASTM D4239
☒ Neutral Water	drums, containers, tanks, rinse and decon water	Ignitability	1010

Sample Source	Contaminant Sources	Recommended Analysis	Analytical Methods
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		TAL Metals	6010B/7000/7470
		Density	SM213E
		Total Organic Halogens (TOX)	9020B
		Total Organic Carbon (TOC)	9060
		Total Solids	EPA 160.3
		Total Suspended Solids	EPA 160.2
		Total Dissolved Solids	EPA 160.1
		Acidity	EPA 305.1
		Alkalinity	EPA 310.1/310.2
		Total Ammonia	EPA 350.2
☒ Neutral Inert Solids	containers, tanks	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		Density	SM213E
		Total Organic Halogens (TOX)	9020B
		Total Solids	EPA 160.3
		Total Phenols	9065/9066/9067
☒ Debris	crushed drums, PPE	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311//8151A
		TCLP Metals	1311/6010B/7000/7470
		Paint Filter Test (free liquids)	9095A
		Density	SM213E
☒ Soil [2]	contaminated soil	Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470

Sample Source	Contaminant Sources	Recommended Analysis	Analytical Methods
		Density	SM213E
		Total Organic Halogens	9020B
		Total Phenols	9065/9066/9067
		Paint Filter Test (free liquids)	9095A
		Total Solids	EPA 160.3
☒ Oxidizers	drums, containers, tanks	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		Density	SM213E
		DOT Oxidizer Test	49 CFR Part 173 Appendix F
☒ Waste Oils	drums, containers, tanks	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		TCL Volatiles	8260B
		TCL Semivolatiles	8270C
		PCBs	8082
		TAL Metals	6010B/7000 /7470
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311//8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010B/7000/7470
		Density	SM213E
		Total Organic Halogens (TOX)	9020A
		% ASH	1209/D2974
		BTU	BTU- D240-76
		% Water	Karl Fischer
		Chlorine content	ASTM D808/EPA 300.0
		Bromine content	ASTM D808/EPA 300.0
		Iodine content	ASTM E442/D3869C
		Sulfur content	ASTM D4239
☒ Site Debris	Debris piles	Ignitability	1010
		Corrosivity pH	9040B
		Reactivity	SW-846 7.3.3.2, 7.3.4.2
		PCBs	8082
		TCLP Volatiles	1311/8260B
		TCLP Semivolatiles	1311/8270C
		TCLP Pesticides	1311/8081A
		TCLP Herbicides	1311/8151A
		TCLP Metals	1311/6010A/7000/7470
		Density	SM213E
		Paint Filter Test (free liquids)	9095

Notes:
[1] No analytical may be required if the material is cleaned in accordance with the standard in 40 CFR Part 268.45.
[2] Some states may require additional parameters than those listed (i.e., Pennsylvania's Form U).

Appendix B contains a brief description of the various sampling approaches listed in Table 6.

Table 6 Sampling Approaches

Type of Sample	Sampling Approach	Background Sample Collection	Composite Scheme*
☒ Drum Liquid	Judgmental	NA	☐1 or ☒ 2
☐ Drum Liquid	Random	NA	☐1 or ☐ 2
☒ Drum Solid	Judgmental	NA	☐1 or ☒ 2
☐ Drum Solid	Random	NA	☐1 or ☐ 2
☐ Drum Solid	Systematic Random	NA	☐1 or ☐ 2
☒ Tank Liquid	Judgmental	NA	☐1 or ☒ 2
☐ Tank Liquid	Random	NA	☐1 or ☐ 2
☐ Tank Liquid	Stratified Random	NA	☐1 or ☐ 2
☐ Tank Liquid	Systematic Random	NA	☐1 or ☐ 2
☐ Tank Liquid	Systematic Grid	NA	☐1 or ☐ 2
☒ Tank Solid	Judgmental	NA	☐1 or ☒ 2
☐ Tank Solid	Random	NA	☐1 or ☐ 2
☐ Tank Solid	Stratified Random	NA	☐1 or ☐ 2
☐ Tank Solid	Systematic Random	NA	☐1 or ☐ 2
☐ Tank Solid	Systematic Grid	NA	☐1 or ☐ 2
☒ Waste Pile	Judgmental	NA	☐1 or ☒ 2
☐ Waste Pile	Random	NA	☐1 or ☐ 2
☐ Waste Pile	Stratified Random	NA	☐1 or ☐ 2
☐ Waste Pile	Systematic Random	NA	☐1 or ☐ 2
☐ Waste Pile	Systematic Grid	NA	☐1 or ☐ 2
☐ Waste Pile	Hot Spots	NA	☐1 or ☐ 2
☒ Soil	Judgmental	☐Y or ☒N	☐1 or ☒ 2
☐ Soil	Random	☐Y or ☐N	☐1 or ☐ 2
☐ Soil	Stratified Random	☐Y or ☐N	☐1 or ☐ 2
☐ Soil	Systematic Random	☐Y or ☐N	☐1 or ☐ 2
☐ Soil	Systematic Grid	☐Y or ☐N	☐1 or ☐ 2
☒ Soil	Hot Spots	☐Y or ☒N	☐1 or ☒ 2
☐ Sediment	Judgmental	☐Y or ☐N	☐1 or ☐ 2
☐ Sediment	Random	☐Y or ☐N	☐1 or ☐ 2
☐ Sediment	Stratified Random	☐Y or ☐N	☐1 or ☐ 2
☐ Sediment	Systematic Random	☐Y or ☐N	☐1 or ☐ 2
☐ Sediment	Systematic Grid	☐Y or ☐N	☐1 or ☐ 2
☐ Groundwater	Random	☐Y or ☐N	☐1 or ☐ 2
☐ Groundwater	Systematic Random	☐Y or ☐N	☐1 or ☐ 2
☐ Surface water	Judgmental	☐ upstream or ☐N	☐1 or ☐ 2
☐ Surface water	Random	☐ upstream or ☐N	☐1 or ☐ 2
☐ Surface water	Systematic Random	☐ upstream or ☐N	☐1 or ☐ 2

*The composite schemes are as follows:

1 = Samples will not be composited.

2 = Samples exhibiting like characteristics will be composited and a grab sample taken from the composite. Samples to be analyzed for volatile organics will not be composited.

5.0 SAMPLING REQUIREMENTS AND COLLECTIONS

Table 7, Sampling Requirements Summary, contains information pertinent to sampling, such as the sample container types and the quantity to be collected at each sampling location, the preservation method to be utilized, and the sample holding times (based on the parameter being analyzed for and the matrix).

Table 7 Sampling Requirements Summary

Analytical Group	Soil/Sediment			Water/Wastewater[1]			Waste		
	Cont	Pres	Hold	Cont	Pres	Hold	Cont	Pres	Hold
Biological									
Bacteriological*	--	--	--	B	I	6hr	--	--	--
Toxicity, Acute	--	--	--	CU	I	2	--	--	--
Toxicity, Chronic	--	--	--	CU	I	2	--	--	--
Inorganics									
pH*	8G	NA	--	--	--	--	8G	NA	N
Dermal Corrosion	--	--	--	--	--	--	8G	NA	N
Flashpoint	--	--	--	--	--	--	8G	NA	N
BTU Content	--	--	--	--	--	--	8G	NA	N
Ash Content	--	--	--	--	--	--	8G	NA	N
Residual Chlorine*	--	--	--	SM	NA	I	--	--	--
Turbidity	--	--	--	SM	I	2	--	--	--
Conductivity	--	--	--	SM	I	28[11]	--	--	--
Temperature*	--	--	--	SM	NA	I	--	--	--
BOD5	--	--	--	HP[2]	I	2	--	--	--
Solids Series	--	--	--	HP	I	7	--	--	--
Settleable Solids	--	--	--	HP	I	2	--	--	--
Nutrients (N,P)	8G	I	NS	HP	S/I	28	--	--	--
Chloride	--	--	--	LP	NA	28	--	--	--
Ortho-P	8G	I	NS	LP	I[4]	2	--	--	--
Dissolved P	--	--	--	LP	S[4]/I	28	--	--	--
COD	8G	I	NS	LP	S/I	28	--	--	--
Alkalinity	--	--	--	LP	I	14	--	--	--
Color	--	--	--	GP	I	2	--	--	--
Oil & Grease*	--	--	--	LG	S/I	28	--	--	--
Metals	8G	I	180	LP	N	180	8G	NA	180
Mercury	8G	I	28	LP	N	28	8G	NA	28
Metals – TCLP (except Mercury)	8G	I	360[12]	LP	I	360[12]	8G	NA	360[12]
Mercury - TCLP	8G	I	56[19]	LP	I	56[19]	8G	NA	56[19]
Chromium VI	--	--	--	LP	I	1	--	--	--
Cyanide	--	--	--	LP	A[5]/C[6]/I	14	8G	NA	14
Sulfides	--	--	--	LP	Z/C[7]/I	7	--	--	--
Sulfates	--	--	--	LP	I	28	--	--	--
Nitrite	--	--	--	LP	I	2	--	--	--
Nitrate	--	--	--	HP	I	2	--	--	--
Hardness	--	--	--	LP	N	180	--	--	--
Fluoride	--	--	--	LP	NA	28	--	--	--
Organics									

Analytical Group	Soil/Sediment			Water/Wastewater[1]			Waste		
	Cont	Pres	Hold	Cont	Pres	Hold	Cont	Pres	Hold
VOCs[*]	2G	I	14	V	B[8]/I	14/7[16]	8G	NA	14
VOCs - TCLP[*]	2G	I	28[13]	V	I	28[13]	8G	NA	28[13]
Extractables[19]	8G	I	54[18]	GG	I[9]	47[17]	8G	NA	54[18]
Extractables - TCLP	8G	I	61[14]	GG	I	61[14]	8G	NA	61[14]
Dioxins[20]	A	I	75[15]	LA[3]	I[10]	75[15]	A	I	75[15]
Percent Alcohol	8G	I	NS	GG	I	NS	8G	NA	NS
Phenols	--	--	--	LA	S/I	28	--	--	--
Org Halide (TOX)	8G	I	28	LA	S/I	28	--	--	--

General Footnotes:

Cont - Container
Pres - Preservation
Hold - Holding Time (days)
* - Grab sample only, unless indicated a grab or composite is acceptable.
1 - Consult 40 CFR Part 136 Table II. - Required Containers, Preservation Techniques, and Holding Times for latest requirements.
19 - Including pesticides, herbicides and PCBs
20 - Consult local laboratory for most recent dioxin container and preservation requirements.

Containers:

B - Bacteriological container
CU - Cubitainer: one gallon or 2 gallon
8G - 8 oz. widemouth glass (Teflon lid)
2G - 2 oz. widemouth glass (Teflon septum lid)
LP - One liter polyethylene
GG - One gallon amber glass (Teflon lid)
V - 40 ml glass (Teflon septum lid)
SM - Stormore 500 ml polyethylene
LG - One liter widemouth glass (Teflon lid)
GP - Gallon polyethylene
HP - Half-gallon polyethylene
LA - One liter amber glass (Teflon lid)
A - 500 ml widemouth amber glass (Teflon lid)
2 - Use GP for BOD with multiple parameters
3 - Collect 2 sample containers (LA) per sample plus 4 at one location for matrix spike

Preservatives:

A - Ascorbic acid
B - Sodium bisulfite
C - NaOH
H - HCl
I - Ice (4oC)
N - 50% HNO3 (pH < 2.0 S.U.)
NA - Not applicable
S - 50% H2SO4 (pH < 2.0 S.U.)
Z - Zinc acetate

4 - Filter on-site
5 - Only with residual CL2
6 - To pH > 12.0 S.U.
7 - To pH > 9.0 S.U.
8 - With residual CL2 mix sample in 8-oz. glass container with 8 drops 25% ascorbic acid
9 - With residual CL2 mix sample with 0.008% sodium thiosulfate
10 - With residual CL2 mix sample with 80 mg of sodium thiosulfate per liter

Holding Times: in days unless noted otherwise:

NS - Not Specified
N - Indefinite
I - Immediate (within 15 minutes: 40 CFR 136 Table II)
11 - Determine on-site if possible
12 - 360 days: 180 days to extraction plus 180 days to analysis
13 - 28 days: 14 days to TCLP extraction plus 14 days to analysis (7 days if not preserved following extraction)
14 - 61 days: 14 days to TCLP extraction, 7 days to solvent extraction, 40 days to analysis
15 - Method 8290 specifies 30 days to extraction plus 45 days to analysis
16 - 7 days if not preserved
17 - 47 days: 7 days to extraction, 40 days to analysis
18 - 54 days: 14 days to extraction, 40 days to analysis
19 - 56 days: 28 days to extraction plus 28 days to analysis

Table 8 shows the sampling equipment/media will be used to obtain environmental samples from the respective matrix.

Table 8 Sampling Equipment/Media

Parameter/Matrix	Equipment/Media	Fabrication	Dedicated
☒ TCLP/Drum Liquid	Drum Thief	Glass	Yes
☒ TCLP/Drum Liquid	Coliwasa	Glass	Yes
☐ TCLP/ Drum Solid	Sample Thief	PVC	Yes
☐ TCLP/ Drum Solid	Sample Thief	Stainless Steel	☐Y / ☐N
☒ TCLP/ Drum Solid	Spoon	Stainless Steel	☒Y / ☐N
☒ TCLP/ Waste Pile	Spoon	Stainless Steel	☒Y / ☐N
☐ TCLP/ Waste Pile	Sample Thief	Stainless Steel	☐Y / ☐N
☐ TCLP/ Tank Liquid	Bacon Bomb	Stainless Steel	☐Y / ☐N
☒ TCLP/ Tank Liquid	Coliwasa	Glass	Yes
☒ TCLP/ Tank Solid	Sample Thief	PVC	Yes
☐ TCLP/ Tank Solid	Sample Thief	Stainless Steel	☐Y / ☐N
☒ TCL/Drum Liquid	Drum Thief	Glass	Yes
☒ TCL/Drum Liquid	Coliwasa	Glass	Yes
☒ TCL/ Drum Solid	Spoon	Stainless Steel	☒Y / ☐N

Parameter/Matrix	Equipment/Media	Fabrication	Dedicated
☒ TCL/ Waste Pile	Spoon	Stainless Steel	☒Y / ☐N
☐ TCL/ Waste Pile	Sample Thief	Stainless Steel	☐Y / ☐N
☐ TCL/ Tank Liquid	Bacon Bomb	Stainless Steel	☐Y / ☐N
☒ TCL/ Tank Liquid	Coliwasa	Glass	Yes
☒ TAL/Drum Liquid	Drum Thief	Glass	Yes
☒ TAL/Drum Liquid	Coliwasa	Glass	Yes
☒ TAL/ Drum Solid	Spoon	Stainless Steel	☒Y / ☐N
☒ TAL/ Waste Pile	Spoon	Stainless Steel	☒Y / ☐N
☐ TAL/ Waste Pile	Sample Thief	Stainless Steel	☐Y / ☐N
☐ TAL/ Tank	Bacon Bomb	Stainless Steel	☐Y / ☐N
☒ TAL/ Tank	Coliwasa	Glass	Yes
☐ TCLP/Sediment	Dredges	Stainless Steel/Brass	No
☐ TCLP/Sediment	Coring	Stainless Steel or Teflon	☐Y / ☐N
☐ TCLP/Sediment	Scoops/Spoon	Stainless Steel	☐Y / ☐N
☐ TCL/Sediment	Dredges	Stainless Steel/Brass	No
☐ TCL/Sediment	Coring	Stainless Steel or Teflon	☐Y / ☐N
☐ TCL/Sediment	Scoops/Spoon	Stainless Steel	☐Y / ☐N
☐ TAL/Sediment	Dredges	Stainless Steel/Brass	No
☐ TAL/Sediment	Coring	Stainless Steel or Teflon	☐Y / ☐N
☐ TAL/Sediment	Scoops/Spoon	Stainless Steel	☐Y / ☐N
☒ TCLP/Soil	Spoon/Trowel	Stainless Steel	☒Y / ☐N
☐ TCLP/ Soil	Hand Auger	Stainless Steel	☐Y / ☐N
☐ TCLP/ Soil	Drill Rig/Back hoe	Carbon Steel	No
☒ TCL/ Soil	Spoon/Trowel	Stainless Steel	☒Y / ☐N
☐ TCL/ Soil	Hand Auger	Stainless Steel	☐Y / ☐N
☐ TCL/ Soil	Drill Rig/Back hoe	Carbon Steel	No
☒ TAL/ Soil	Spoon/Trowel	Stainless Steel	☒Y / ☐N
☐ TAL/ Soil	Hand Auger	Stainless Steel	☐Y / ☐N
☐ TAL/ Soil	Drill Rig/Back hoe	Carbon Steel	No

6.0 SAMPLING STANDARD OPERATING PROCEDURES

The following sampling SOPs will be implemented for this project (copies included in Appendix C) as applicable. These are typically procedures that may be varied or changed as required, dependent upon site conditions or equipment limitations. In all instances, the ultimate procedures employed should be documented and associated with the final project deliverables.

- Sampling Equipment and Container Decontamination
- Groundwater Sampling
- Drum Sampling
- Soil Sampling
- Large Vessel Sampling
- Surface Water Sampling

Field decontamination procedures are outlined in Appendix D.

7.0 SAMPLING DOCUMENTATION

All sample documents will be completed legibly and in ink. Any corrections will be made by lining-through the original entry and initialing the change.

7.1 Field Logbook

All sample documents will be completed legibly and in ink. Any corrections will be made by lining through the original entry and initialing the change. The following sample documentation will be maintained as necessary:

- Site name
- Names of personnel on site
- Dates and times of all entries
- Descriptions of all site activities
- Noteworthy events and discussions
- Weather conditions
- Site observations
- Identification and description of samples and locations
- Subcontractor information and names of on-site personnel
- Dates and times of sample collection and Chain of Custody (COC) information
- Records of photographs
- Site sketches
- Sample Labels
- Site name and project number
- Date and time the sample was collected
- Sample preservation
- Sampling location
- Chain-of Custody Record
- Sample identification
- Sample location
- Sample collection date and time
- Sample information (e.g., matrix, number of bottles, etc.)
- Names and signatures of samplers
- Signatures of all individuals who have had custody of the samples

7.2 Sampling Handling and Shipment

Environmental samples will be packaged and shipped as described below.

1. Samples will be shipped per Department of Transportation (DOT) and International Air Transportation Association (IATA) guidelines.
2. All sample containers will be placed in waterproof metal or equivalent plastic ice chests or coolers only.
3. After the pertinent information is on the sample label and tag, if required, the tag is secured around the sample container lid.
4. The volume level of the sample in the sample container is marked with a grease pencil.
5. Cushioning material is placed in the bottom of the cooler.

6. The bottles are sealed in clear plastic bags, with labels and tags clearly visible. The enclosed are placed upright in the cooler so that they do not touch during transit.
7. Temperature blanks are used to monitor cooler temperature.
8. Ice bags are placed around, among, and on top of the sample bottles.
9. The cooler is filled with cushioning material.
10. Paperwork is placed in a waterproof plastic bag and closed.
11. The cooler drain is taped shut.
12. The cooler lid is secured with tape by wrapping it around the cooler in at least two places without covering any labels.
13. Completed shipping label is attached to the top of the cooler.
14. If needed, numbered and signed custody seals are affixed on front right and back left of the cooler. The seals are covered with wide, clear tape.
15. Samples will be express-shipped (overnight) to the laboratory under COC protocols previously discussed.

8.0 QUALITY ASSURANCE REQUIREMENTS

The following QA requirements will be implemented on this project:

☒ *Screening Data* ☐ *Screening Data with Definitive Confirmation*

8.1 Screening Data

Screening data are generated by rapid less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and clean up. Screening data provide analyte identification and quantification, although the quantification may be relatively imprecise. At least 10% of the screening data are confirmed using the analytical method and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality. Screening data without associated confirmation data are not considered to be data of known quality.

Screening data QA/QC Elements:

- Sample documentation
- Chain of Custody
- Sampling design approach
- Initial and continuing calibration
- Determination and documentation of detection limits
- Analyte(s) identification
- Analyte(s) quantification

8.2 Screening Data with Definitive Confirmation

For definitive confirmation, at least 10 percent of the screening data are confirmed using analytical methods and quality control procedures and criteria associated with definitive data. Definitive data are generated using rigorous analytical methods, such as EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods generating definitive data produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the quality control requirements are satisfied.

Definitive Data QA/QC Elements:

- Sample results summary
- Cross reference sample ID (laboratory/client
- Sample holding times
- Detection limits and qualifiers
- Internal and external chain of custody documentation
- Initial and continuing calibration data
- Interference check sample (ICP)
- ICP serial dilution
- Initial and continuing blank data (inorganics)
- Method blanks (instrument, extraction, etc.)
- Surrogate spike data with control limits
- Matrix spike/matrix spike duplicate with control limits (organics)
- Matrix spike and duplicate with control limits (inorganics)
- Laboratory Control Sample with control limits
- Internal standard area count and retention time
- GC/MS tuning criteria
- Second column confirmation data
- Raw data
- A case narrative to include cleanup and dilution procedures and interference's encountered
- Performance Evaluation samples (when required)

9.0 DATA VALIDATION

Data generated for this project will be validated as follows:

9.1 Screening Data

Screening data need only be evaluated for calibration and detection limits. Confirmation data generated under this QASAP will be evaluated accordingly with the appropriate criteria listed in Section 8.0 above.

9.2 Definitive Data

This objective requires that at least 10% of the samples in the analytical data package be evaluated for all of the elements listed in Section 8.0 of this QASAP. The remaining samples will be reviewed for holding times, blank contamination, precision, accuracy, detection limits, and confirmed compound identification. This objective also requires review of all elements for all samples in each analyte category in every tenth data package received from the individual lab.

10.0 DELIVERABLES

The KEMRON PM/RM will maintain contact with the USEPA OSC/RPM to provide information regarding the technical and finical progress of the project. This communication will begin when the project is assigned. **All solid/soil/sediment samples that are analyzed for PCBs are required to be reported on a dry-weight basis.**

The items checked below will be included as standard deliverables.

☒ *Analysis*	☒ *Analytical Report*	☒ *Data Review*
☒ *Final Report*	☐ *Maps and Figures*	☐ *Status Report*
☐ *Trip Report*		

Appendix A

Precision and Accuracy Criteria

Estimated Reporting Limits for Method 8260B

Analyte Volatile Organic Compounds SW-8260B	Aqueous Samples		Soil Samples
	Estimated Reporting Limit[b] (µg/L) 5 ml purge	Estimated Reporting Limit[b] (µg/L) 25 ml purge	Estimated Reporting Limit[b] (µg/kg) Low level Soil/sediment
Dichlorodifluoromethane	5	1	5
Chloromethane	5	1	5
Vinyl chloride	5	1	5
Bromomethane	5	1	5
Chloroethane	5	1	5
Trichlorofluoromethane	5	1	5
1,1-Dichloroethene	5	1	5
Methylene chloride	5	1	5
trans-1,2-Dichloroethene	5	1	5
1,1-Dichloroethane	5	1	5
2,2-Dichloropropane	5	1	5
cis-1,2-Dichloroethene	5	1	5
Chloroform	5	1	5
Bromochloromethane	5	1	5
1,1,1-Trichloroethane	5	1	5
Carbon tetrachloride	5	1	5
1,1-Dichloropropene	5	1	5
Benzene	5	1	5
1,2-Dichloroethane	5	1	5
Trichloroethene	5	1	5
1,2-Dichloropropane	5	1	5
Bromodichloromethane	5	1	5
Dibromomethane	5	1	5
cis-1,3-Dichloropropene	5	1	5
Toluene	5	1	5
Trans-1,3-Dichloropropene	5	1	5
1,1,2-Trichloroethane	5	1	5
Tetrachloroethene	5	1	5
1,3-Dichloropropane	5	1	5
Dibromochloromethane	5	1	5
1,2-Dibromoethane	5	1	5
1-Chlorohexane	5	1	5
Chlorobenzene	5	1	5
1,1,1,2-Tetrachloroethane	5	1	5
Ethyl benzene	5	1	5
p-Xylene	5	1	5
m-Xylene	5	1	5
o-Xylene	5	1	5
Styrene	5	1	5
Bromoform	5	1	5
Isopropylbenzene	5	1	5
1,1,2,2-Tetrachloroethane	5	1	5
Bromobenzene	5	1	5
1,2,3-Trichloropropane	5	1	5

Analyte Volatile Organic Compounds SW-8260B	**Aqueous Samples**		**Soil Samples**
	Estimated Reporting Limit[(b)] (µg/L) 5 ml purge	**Estimated Reporting Limit[(b)] (µg/L) 25 ml purge**	**Estimated Reporting Limit[(b)] (µg/kg) Low level Soil/sediment**
n-Propylbenzene	5	1	5
2-Chlorotoluene	5	1	5
1,3,5-Trimethylbenzene	5	1	5
4-Chlorotoluene	5	1	5
tert-Butylbenzene	5	1	5
1,2,4-Trimethylbenzene	5	1	5
sec-Butylbenzene	5	1	5
p-Isopropyltoluene	5	1	5
1,3-Dichlorobenzene	5	1	5
1,4-Dichlorobenzene	5	1	5
n-Butylbenzene	5	1	5
1,2-Dichlorobenzene	5	1	5
1,2-Dibromo-3-chloropropane	5	1	5
1,2,4-Trichlorobenzene	5	1	5
Hexachlorobutadiene	5	1	5
Naphthalene	5	1	5
1,2,3-Trichlorobenzene	5	1	5

QC Acceptance Criteria for Method 8260B

Analyte Volatile Organic Compounds SW-8260B	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (%R)	Precision Soil (% RPD)
Dichlorodifluoromethane	75-125	≤ 20	65-140	≤ 30
Chloromethane	75-125	≤ 20	65-140	≤ 30
Vinyl chloride	40-125	≤ 20	30-145	≤ 30
Bromomethane	75-125	≤ 20	65-140	≤ 30
Chloroethane	60-125	≤ 20	50-140	≤ 30
Trichlorofluoromethane	65-125	≤ 20	55-140	≤ 30
1,1-Dichloroethene	75-125	≤ 20	65-140	≤ 30
Methylene chloride	75-125	≤ 20	65-140	≤ 30
trans-1,2-Dichloroethene	75-125	≤ 20	65-140	≤ 30
1,1-Dichloroethane	75-125	≤ 20	65-140	≤ 30
2,2-Dichloropropane	75-125	≤ 20	65-140	≤ 30
cis-1,2-Dichloroethene	75-125	≤ 20	65-140	≤ 30
Chloroform	75-125	≤ 20	65-140	≤ 30
Bromochloromethane	75-125	≤ 20	65-140	≤ 30
1,1,1-Trichloroethane	75-125	≤ 20	65-140	≤ 30
Carbon tetrachloride	60-125	≤ 20	50-140	≤ 30
1,1-Dichloropropene	75-125	≤ 20	65-140	≤ 30
Benzene	75-125	≤ 20	65-140	≤ 30
1,2-Dichloroethane	65-125	≤ 20	65-140	≤ 30
Trichloroethene	75-125	≤ 20	65-140	≤ 30
1,2-Dichloropropane	75-125	≤ 20	65-140	≤ 30
Bromodichloromethane	75-125	≤ 20	65-140	≤ 30
Dibromomethane	65-125	≤ 20	55-140	≤ 30
cis-1,3-Dichloropropene	75-125	≤ 20	65-140	≤ 30
Toluene	75-125	≤ 20	65-140	≤ 30
Trans-1,3-Dichloropropene	65-125	≤ 20	55-140	≤ 30
1,1,2-Trichloroethane	75-125	≤ 20	65-140	≤ 30
Tetrachloroethene	75-125	≤ 20	65-140	≤ 30
1,3-Dichloropropane	75-125	≤ 20	65-140	≤ 30
Dibromochloromethane	70-125	≤ 20	60-140	≤ 30
1,2-Dibromoethane	75-125	≤ 20	65-140	≤ 30
1-Chlorohexane	75-125	≤ 20	65-140	≤ 30
Chlorobenzene	75-125	≤ 20	65-140	≤ 30
1,1,1,2-Tetrachloroethane	75-125	≤ 20	65-140	≤ 30
Ethyl benzene	75-125	≤ 20	65-140	≤ 30
p-Xylene	75-125	≤ 20	65-140	≤ 30
m-Xylene	75-125	≤ 20	65-140	≤ 30
o-Xylene	75-125	≤ 20	65-140	≤ 30
Styrene	75-125	≤ 20	65-140	≤ 30
Bromoform	75-125	≤ 20	65-140	≤ 30
Isopropylbenzene	75-125	≤ 20	65-140	≤ 30
1,1,2,2-Tetrachloroethane	75-125	≤ 20	65-140	≤ 30
Bromobenzene	75-125	≤ 20	65-140	≤ 30
1,2,3-Trichloropropane	75-125	≤ 20	65-140	≤ 30
n-Propylbenzene	75-125	≤ 20	65-140	≤ 30

Analyte Volatile Organic Compounds SW-8260B	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (%R)	Precision Soil (% RPD)
2-Chlorotoluene	75-125	≤ 20	65-140	≤ 30
1,3,5-Trimethylbenzene	70-125	≤ 20	60-140	≤ 30
4-Chlorotoluene	75-125	≤ 20	65-140	≤ 30
tert-Butylbenzene	75-125	≤ 20	65-140	≤ 30
1,2,4-Trimethylbenzene	75-125	≤ 20	65-140	≤ 30
sec-Butylbenzene	75-125	≤ 20	65-140	≤ 30
p-Isopropyltoluene	75-125	≤ 20	65-140	≤ 30
1,3-Dichlorobenzene	75-125	≤ 20	65-140	≤ 30
1,4-Dichlorobenzene	75-125	≤ 20	65-140	≤ 30
n-Butylbenzene	75-125	≤ 20	65-140	≤ 30
1,2-Dichlorobenzene	75-125	≤ 20	65-140	≤ 30
1,2-Dibromo-3-chloropropane	55-125	≤ 20	40-140	≤ 30
1,2,4-Trichlorobenzene	75-125	≤ 20	65-140	≤ 30
Hexachlorobutadiene	75-125	≤ 20	65-140	≤ 30
Naphthalene	75-125	≤ 20	65-140	≤ 30
1,2,3-Trichlorobenzene	75-125	≤ 20	65-140	≤ 30
Surrogates				
Dibromofluoromethane	75-125		65-140	
Toluene-d8	75-125		65-140	
4-Bromofluorobenzene	75-125		65-140	
1,2-Dichloroethane-d4	60-140		50-150	

Estimated Reporting Limits for Method 8270C

Analyte Semi-volatile Organic Compounds SW-8270C	Aqueous Samples	Soil Samples
	Estimated Reporting Limit (µg/l)	Estimated Reporting Limit (µg/kg) Low level Soil/sediment
Acenapthene	10	660
Acenaphthylene	10	660
Anthracene	10	660
Benzo(a)anthracene	10	660
Benzo(b)fluoranthene	10	660
Benzo(k)fluoranthene	10	660
Benzoic acid	50	3300
Benzo(g,h,i)perylene	10	660
Benzo(a)pyrene	10	660
Benzyl alcohol	20	1300
Bis(2-Chloroethoxy) methane	10	660
Bis(2-Chloroethyl) ether	10	660
Bis(2-Chloroisopropyl) ether	10	660
4-Bromophenyl phenyl ether	10	660
Butyl benzyl phthalate	10	660
4-Chloroaniline	20	1300
4-Chloro-3-methylphenol	20	1300
2-Chloronaphthalene	10	660
2-Chlorophenol	10	660
4-Chlorophenyl phenyl ether	10	660
Chrysene	10	660
Dibenz(a,h)anthracene	10	660
Dibenzofuran	10	660
Di-n-butylphthalate	10	660
1,2-Dichlorobenzene	10	660
1,3-Dichlorobenzene	10	660
1,4-Dichlorobenzene	10	660
3,3 '-Dichlorobenzidine	20	1300
2,4-Dichlorophenol	10	660
Diethylphthalate	10	660
2,4-Dimethylphenol	10	660
Dimethyl phthalate	10	660
4,6-Dinitro-2-methylphenol	50	3300
2,4-Dinitrophenol	50	3300
2,4-Dinitrotoluene	10	660
2,6-Dinitrotoluene	10	660
Di-n-octyl phthalate	10	660
bis(2-Ethylhexyl)phthalate	10	660
Ethyl methanesulfonate	20	ND
Fluoranthene	10	660
Fluorene	10	660
Hexachlorobenzene	10	660
Hexachlorobutadiene	10	660

Analyte Semi-volatile Organic Compounds SW-8270C	Aqueous Samples	Soil Samples
	Estimated Reporting Limit (µg/l)	Estimated Reporting Limit (µg/kg) Low level Soil/sediment
Hexachlorocyclopentadiene	10	660
Hexachloroethane	10	660
Indeno(1,2,3-cd)pyrene	10	660
Isophorone	10	660
2-Methylnaphthalene	10	660
2-Methylphenol	10	660
4-Methylphenol	10	660
Naphthalene	10	660
2-Nitroaniline	50	3300
3-Nitroaniline	50	3300
4-Nitroaniline	20	3300
Nitrobenzene	10	660
2-Nitrophenol	10	660
4-Nitrophenol	50	3300
N-Nitrosodiphenylamine	10	660
N-Nitroso-di-n-propylamine	10	660
Pentachlorophenol	50	3300
Phenanthrene	10	660
Phenol	10	660
Pyrene	10	660
1,2,4-Trichlorobenzene	10	660
2,4,5-Trichlorophenol	10	660
2,4,6-Trichlorophenol	10	660

QC Acceptance Criteria for Method 8270C

Analyte Semi-volatile Organic Compounds SW-8270C	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (%R)	Precision Soil (% RPD)
Acenapthene	45-125	≤ 20	35-135	≤ 30
Acenaphthylene	45-125	≤ 20	35-135	≤ 30
Anthracene	45-165	≤ 20	35-175	≤ 30
Benzo(a)anthracene	50-135	≤ 20	40-145	≤ 30
Benzo(b)fluoranthene	35-125	≤ 20	25-135	≤ 30
Benzo(k)fluoranthene	35-125	≤ 20	25-135	≤ 30
Benzoic acid	25-160	≤ 20	20-170	≤ 30
Benzo(g,h,i)perylene	35-150	≤ 20	25-160	≤ 30
Benzo(a)pyrene	40-125	≤ 20	30-135	≤ 30
Benzyl alcohol	35-125	≤ 20	25-135	≤ 30
bis(2-Chloroethoxy) methane	45-125	≤ 20	35-135	≤ 30
bis(2-Chloroethyl) ether	45-125	≤ 20	30-135	≤ 30
bis(2-Chloroisopropyl) ether	35-170	≤ 20	25-175	≤ 30
4-Bromophenyl phenyl ether	50-130	≤ 20	40-140	≤ 30
Butyl benzyl phthalate	25-125	≤ 20	25-135	≤ 30
4-Chloroaniline	45-140	≤ 20	35-150	≤ 30
4-Chloro-3-methylphenol	40-125	≤ 20	40-145	≤ 30
2-Chloronaphthalene	60-125	≤ 20	50-135	≤ 30
2-Chlorophenol	40-125	≤ 20	30-135	≤ 30
4-Chlorophenyl phenyl ether	50-130	≤ 20	30-135	≤ 30
Chrysene	55-135	≤ 20	45-145	≤ 30
Dibenz(a,h)anthracene	50-125	≤ 20	40-135	≤ 30
Dibenzofuran	50-125	≤ 20	40-135	≤ 30
Di-n-butylphthalate	30-130	≤ 20	25-140	≤ 30
1,2-Dichlorobenzene	40-160	≤ 20	30-135	≤ 30
1,3-Dichlorobenzene	30-125	≤ 20	25-135	≤ 30
1,4-Dichlorobenzene	30-125	≤ 20	25-135	≤ 30
3,3 '-Dichlorobenzidine	25-175	≤ 20	25-175	≤ 30
2,4-Dichlorophenol	45-125	≤ 20	35-135	≤ 30
Diethylphthalate	35-125	≤ 20	25-135	≤ 30
2,4-Dimethylphenol	45-140	≤ 20	35-150	≤ 30
Dimethyl phthalate	25-175	≤ 20	25-175	≤ 30
4,6-Dinitro-2-methylphenol	25-135	≤ 20	25-145	≤ 30
2,4-Dinitrophenol	30-150	≤ 20	25-160	≤ 30
2,4-Dinitrotoluene	35-140	≤ 20	25-150	≤ 30
2,6-Dinitrotoluene	50-125	≤ 20	40-135	≤ 30
Di-n-octyl phthalate	35-130	≤ 20	25-140	≤ 30
bis(2-Ethylhexyl)phthalate	30-140	≤ 20	25-140	≤ 30
Fluoranthene	45-125	≤ 20	35-135	≤ 30
Fluorene	45-140	≤ 20	35-150	≤ 30
Hexachlorobenzene	45-135	≤ 20	35-145	≤ 30
Hexachlorobutadiene	25-125	≤ 20	25-135	≤ 30
Hexachlorocyclopentadiene	40-125	≤ 20	30-135	≤ 30
Hexachloroethane	25-135	≤ 20	25-160	≤ 30
Indeno(1,2,3-cd)pyrene	25-160	≤ 20	25-170	≤ 30

Analyte Semi-volatile Organic Compounds SW-8270C	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (%R)	Precision Soil (% RPD)
Isophorone	25-175	≤ 20	25-175	≤30
2-Methylnaphthalene	40-125	≤ 20	30-135	≤30
2-Methylphenol	25-125	≤ 20	25-135	≤30
4-Methylphenol	30-125	≤ 20	25-135	≤30
Naphthalene	50-125	≤ 20	40-135	≤30
2-Nitroaniline	50-125	≤ 20	40-135	≤30
3-Nitroaniline	50-125	≤ 20	40-135	≤30
4-Nitroaniline	40-145	≤ 20	30-155	≤30
Nitrobenzene	45-135	≤ 20	35-145	≤30
2-Nitrophenol	40-125	≤ 20	35-135	≤30
4-Nitrophenol	25-135	≤ 20	25-140	≤30
N-Nitrosodiphenylamine	25-125	≤ 20	25-135	≤30
N-Nitroso-di-n-propylamine	35-125	≤ 20	25-135	≤30
Pentachlorophenol	25-140	≤ 20	35-150	≤30
Phenanthrene	50-125	≤ 20	40-135	≤30
Phenol	25-125	≤ 20	25-135	≤30
Pyrene	45-140	≤ 20	35-150	≤30
1,2,4-Trichlorobenzene	40-140	≤ 20	30-150	≤30
2,4,5-Trichlorophenol	25-175	≤ 20	25-175	≤30
2,4,6-Trichlorophenol	35-130	≤ 20	25-140	≤30
Surrogates:				
2,4,6-Tirbromophenol	25-135		25-145	
2-Fluorobiphenyl	40-125		30-135	
2-Fluorophenol	25-125		25-135	
Nitrobenzene-d5	30-125		25-135	
Phenol-d5	25-125		25-135	
Terphenyl-d14	40-130		30-140	

Estimated Reporting Limits for Method 8081A

Analyte Organochlorine Pesticides SW-8081A	GC/ECD Estimated Reporting Limit[a] (µg/L)	GC/ECD Estimated Reporting Limit[b] (µg/kg)
Aldrin	0.05	1.75
a-BHC	0.05	1.75
b-BHC	0.05	1.75
d-BHC	0.05	1.75
g-BHC	0.05	1.75
a-Chlordane	0.05	1.75
g-Chlordane	0.05	1.75
4,4 ¢-DDD	0.10	3.3
4,4 ¢-DDE	0.10	3.3
4,4 ¢-DDT	0.10	3.3
Dieldrin	0.10	3.3
Endosulfan I	0.05	1.75
Endosulfan II	0.10	3.3
Endosulfan sulfate	0.10	3.3
Endrin	0.10	3.3
Endrin aldehyde	0.10	3.3
Endrin ketone	0.10	3.3
Heptachlor	0.05	1.75
Heptachlor epoxide	0.05	1.75
Methoxychlor	0.50	17
Toxaphene	5.0	170

Notes:

(a) Estimated reporting limits are calculated by multiplying the estimated detection limit times a factor of 10; estimated detection limit defined as either the MDL (40 CFR Part 136, Appendix B, Revision1.11), or a concentration of analyte in a sample yielding a peak in the final extract with signal-to-noiseratio of approximately 5, whichever value is higher.

(b) Estimated reporting limits are calculated by multiplying the estimated detection limit times a factor of 10. Detection limits determined from standard solutions corrected back to 50 g samples, extracted and concentrated to 10 mL, with 5 µL injected. Chromatography using narrow bore capillary column.

QC Acceptance Criteria for Method 8081A

Analyte Method 8081A	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (%R)	Precision Soil (% RPD)
Aldrin	45-125	≤ 30	25-135	≤ 50
a-BHC	75-125	≤ 30	55-135	≤ 50
b-BHC	50-125	≤ 30	35-135	≤ 50
d-BHC	75-125	≤ 30	55-140	≤ 50
g-BHC	70-125	≤ 30	55-135	≤ 50
a-Chlordane	45-125	≤ 30	30-140	≤ 50
g-Chlordane	45-125	≤ 30	30-140	≤ 50
4,4 ¢-DDD	45-140	≤ 30	35-150	≤ 50
4,4 ¢-DDE	45-140	≤ 30	30-150	≤ 50
4,4 ¢-DDT	30-145	≤ 30	20-160	≤ 50
Dieldrin	40-130	≤ 30	30-145	≤ 50
Endosulfan I	50-140	≤ 30	35-155	≤ 50
Endosulfan II	75-160	≤ 30	60-170	≤ 50
Endosulfan sulfate	45-140	≤ 30	30-155	≤ 50
Endrin	45-135	≤ 30	30-145	≤ 50
Endrin aldehyde	75-150	≤ 30	60-160	≤ 50
Endrin ketone	65-135	≤ 30	60-160	≤ 50
Heptachlor	45-130	≤ 30	30-140	≤ 50
Heptachlor epoxide	50-135	≤ 30	40-145	≤ 50
Methoxychlor	70-140	≤ 30	60-155	≤ 50
Toxaphene	40-130	≤ 30	30-140	≤ 50
Surrogates				
DCBP	30-135		30-135	
TMX	40-125		40-125	

Estimated Reporting Limits for Method 8151A

Analyte Chlorinated Phenoxy Acid Herbicides SW-8151A	Aqueous Samples	Soil Samples
	GC/ECD Estimated Reporting Limit (µg/l)	Estimated Reporting Limit (µg/kg) Low level Soil/sediment
Acifluorfen	0.96	NA
Bentazon	2.0	NA
Chloramben	0.93	40
2,4-D	2.0	1.1
Dalapon	13	1.2
2,4-DB	8.0	NA
DCPA diacid(d)	0.2	NA
Dicamba	0.81	NA
3,5-Dichlorobenzoic acid	0.61	3.8
Dichloroprop	2.6	NA
Dinoseb	1.9	NA
5-Hydroxydicamba	4.0	NA
MCPP	0.9(c)	660
MCPA	0.56(c)	430
4-Nitrophenol	1.3	3.4
Pentachlorophenol	0.76	1.6
Picloram	1.4	NA
2,4,5-T	0.8	NA
2,4,5-TP (Silvex)	0.75	2.8

Notes:

(a) Estimated reporting limits are calculated by multiplying the estimated detection limit times a factor of 10; estimated detection limit defined as either the MDL (40 CFR Part 136, Appendix B, Revision 1.11), or a concentration of analyte in a sample yielding a peak in the final extract with signal-to-noise ratio of approximately 5, whichever value is higher.

(b) Estimated reporting limits are calculated by multiplying the estimated detection limit times a factor of 10. Detection limits determined from standard solutions corrected back to 50 g samples, extracted and concentrated to 10 mL, with 5 µL injected. Chromatography using narrow bore capillary column, 0.25 □m film, 5% phenyl/95% methyl silicone.

(c) 40 CFR Part 136, Appendix B (49 FR 43234). Chromatography using wide-bore capillary column.

(d) DCPA monoacid and diacid metabolites included in method scope; DCPA diacid metabolite used for validation studies. DCPA is a dimethyl ester.

QC Acceptance Criteria for Method 8151A

Analyte Chlorinated Phenoxy Acid Herbicide SW-8151A	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (%R)	Precision Soil (% RPD)
Acifluorfen	60-125	≤ 30	50-135	≤ 50
Bentazon	60-125	≤ 30	50-135	≤ 50
Chloramben	60-125	≤ 30	50-135	≤ 50
2,4-D	60-125	≤ 30	50-135	≤ 50
Dalapon	60-125	≤ 30	50-135	≤ 50
2,4-DB	60-125	≤ 30	50-135	≤ 50
DCPA diacid[(d)]	60-125	≤ 30	50-135	≤ 50
Dicamba	60-125	≤ 30	50-135	≤ 50
3,5-Dichlorobenzoic acid	60-125	≤ 30	50-135	≤ 50
Dichloroprop	60-125	≤ 30	50-135	≤ 50
Dinoseb	60-125	≤ 30	50-135	≤ 50
5-Hydroxydicamba	60-125	≤ 30	50-135	≤ 50
MCPP	60-125	≤ 30	50-135	≤ 50
MCPA	60-125	≤ 30	50-135	≤ 50
4-Nitrophenol	60-125	≤ 30	50-135	≤ 50
Pentachlorophenol	60-125	≤ 30	50-135	≤ 50
Picloram	60-125	≤ 30	50-135	≤ 50
2,4,5-T	60-125	≤ 30	50-135	≤ 50
2,4,5-TP (Silvex)	60-125	≤ 30	50-135	≤ 50
Surrogates				
2,4-Dichlorophenylacetic acid	60-135	≤ 30	50-150	≤ 50
2,3,5,6-Tetraflourobenzoic acid	70-130	≤ 30	60-140	≤ 50

Estimated Reporting Limits for Method 6010B

Analyte Inorganic Metals SW-6010B	Aqueous Samples	Soil/Sediment Samples
	Estimated Reporting Limit (µg/l)	Estimated Reporting Limit (mg/kg)
Aluminum	200	10
Antimony	60	3
Arsenic	10	0.5
Barium	200	10
Beryllium	5	0.25
Cadmium	5	0.25
Calcium	5000	250
Chromium	10	0.5
Cobalt	50	2.5
Copper	10	0.5
Iron	100	5
Lead	3	0.15
Magnesium	5000	250
Manganese	15	0.75
Nickel	40	2
Potassium	5000	250
Selenium	5	0.25
Silver	10	0.5
Sodium	5000	250
Thallium	10	0.5
Vanadium	50	2.5
Zinc	20	1.0

QC Acceptance Criteria for Method 6010B

Analyte Inorganic Metals SW-6010B	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (%R)	Precision Soil (% RPD)
Aluminum	75-125	≤ 20	60-140	≤ 35
Antimony	75-125	≤ 20	60-140	≤ 35
Arsenic	75-125	≤ 20	60-140	≤ 35
Barium	75-125	≤ 20	60-140	≤ 35
Beryllium	75-125	≤ 20	60-140	≤ 35
Cadmium	75-125	≤ 20	60-140	≤ 35
Calcium	75-125	≤ 20	60-140	≤ 35
Chromium	75-125	≤ 20	60-140	≤ 35
Cobalt	75-125	≤ 20	60-140	≤ 35
Copper	75-125	≤ 20	60-140	≤ 35
Iron	75-125	≤ 20	60-140	≤ 35
Lead	75-125	≤ 20	60-140	≤ 35
Magnesium	75-125	≤ 20	60-140	≤ 35
Manganese	75-125	≤ 20	60-140	≤ 35
Nickel	75-125	≤ 20	60-140	≤ 35
Potassium	75-125	≤ 20	60-140	≤ 35
Selenium	75-125	≤ 20	60-140	≤ 35
Silver	75-125	≤ 20	60-140	≤ 35
Sodium	75-125	≤ 20	60-140	≤ 35
Thallium	75-125	≤ 20	60-140	≤ 35
Vanadium	75-125	≤ 20	60-140	≤ 35
Zinc	75-125	≤ 20	60-140	≤ 35

Estimated Reporting Limits for Method SW7470A/SW7471A

Analyte SW-7470A/7471A	Aqueous Samples	Soil Samples
	Estimated Reporting Limit (mg/L)	Estimated Reporting Limit (mg/Kg)
Mercury	0.001	0.1

QA Acceptance Criteria for Method SW7470A/SW7471A

Analyte SW-7470A/7471A	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (%R)	Precision Soil (% RPD)
Mercury	75-125	≤ 25	70-130	≤ 30

Estimated Reporting Limits for Method SW9010A/SW9012

Analyte SW-9010A/9012	Aqueous Samples
	Estimated Reporting Limit (mg/L)
Total cyanide	0.02

QA Acceptance Criteria for Method SW9010A/SW9012

Analyte SW-9010A/9012	Accuracy Water (% R)	Precision Water (% RPD)
Total cyanide	75-125	≤ 20

Appendix B

Various Sampling Approaches

SAMPLING APPROACHES

Introduction

Development of a sampling design may follow the seven steps outlined in the USEPA publication, "Guidance for the Data Quality Objectives Process." The Data Quality Objectives (DQOs) process is a logical step-by-step method of identifying the study objective, defining the appropriate type of data to collect, clarifying the decisions that will be based on the data collected, and considering the potential limitations with alternate sampling designs. Investigations may be executed without completing the DQO process step-by-step; however, the basic elements of the DQO process should be considered by the project leader for each investigation.

Sampling designs are typically either non-probabilistic (directed sampling designs) or probabilistic (random sampling designs) in nature. The sampling design ultimately must meet specific study objectives. The location and frequency of sampling (number of samples) should be clearly outlined in the sampling design, as well as provisions for access to all areas of the site, the use of special sampling equipment, etc.

Representative Sampling

A "representative sample" is often defined as a sample that reflects one or more characteristics of the population being sampled. For example, the characteristic, which is desired to be reflected by the sample, may be the average, minimum, or maximum concentration of a constituent of concern. Ultimately a representative sample is defined by the study objectives. For instance, the objective of the study may be to determine the maximum concentration of lead in the sludge from a surface impoundment. One sample collected near the inlet to the impoundment may provide that information. The collection of a representative sample may be influenced by factors such as equipment design, sampling techniques, and sample handling.

Stratification and Heterogeneous Wastes

Environmental media, as well as waste matrices, may be stratified, i.e., different portions of the population, which may be separated temporally or spatially, may have similar characteristics or properties which are different from adjacent portions of the population. An example would be a landfill that contains a trench, which received an industrial waste contaminated with chromium. The trench would be considered a strata within the landfill if chromium was the contaminant of concern. A special case, "stratification by component", is often observed with waste matrices when the constituent of interest is associated with one component of the matrix. An example would be slag contaminated with lead that is mixed with otherwise uncontaminated firebrick. Thus the lead is stratified by component, that being the slag. Stratified sampling designs are discussed later which incorporate independent sampling of each strata, thereby reducing the number of samples required.

Some environmental and waste matrices may be, for purposes of the field investigation, homogeneous (for instance the surface water in a limited segment of a small stream). If the composition of the matrix and the distribution of contaminants are known, or can be estimated, less sampling may be necessary to define the properties of interest. An estimate of the variability in contaminant distribution may be based on knowledge, or determined by preliminary sampling. The more heterogeneous the matrix, the greater the planning and sampling requirements.

Specific Sampling Designs

Sampling strategies used by the Branch typically fall into two general groups: directed or probabilistic. Directed or "authoritative" approaches typically rely on the judgement and experience of the investigators, as well as available information on the matrix of concern. Probabilistic, or "statistical" approaches may be appropriate when estimates on uncertainty and specific confidence levels in the results are required. The probabilistic approaches include: simple random sampling, stratified random sampling, and systematic grid sampling. The main feature of a probabilistic approach is that each location at the site has an equal probability of being sampled, therefore statistical bias is minimized.

Authoritative or Directed Sampling

Directed sampling is based on the judgement of the investigator, and does not necessarily result in a sample that reflects the average characteristics of the entire matrix. Directed sampling is also called authoritative or judgmental sampling, and is considered non-probabilistic. The experience of the investigator is often the basis for sample collection, and bias (depending on the study objectives) should be recognized as a potential problem. However, preliminary or screening investigations, and certain regulatory investigations, may correctly employ directed sampling. Directed sampling may focus on "worst case" conditions in a matrix, for example, the most visually contaminated area or the most recently generated waste. In the presence of high temporal or spacial variability, directed samples have a very limited degree of representativeness.

Simple Random Sampling

Simple random sampling insures that each element in the population has an equal chance of being included in the sample. This is often be the method of choice when, for purposes of the investigation, the matrix is considered homogeneous or when the population is randomly heterogeneous. If the population contains trends or patterns of contamination, a stratified random sampling or systematic grid sampling strategy would be more appropriate.

Systematic Sampling Over Time or Space

Systematic sampling over time at the point of generation is useful if the material was sampled from a wastewater sewer, a materials conveyor belt, or being delivered via truck or pipeline. The sampling interval would be determined on a time basis, for example every hour from a conveyor belt or pipeline discharge, or from every third truck load. Systematic sampling over space might involve the collection of samples at defined intervals from a ditch, stream, or other matrix that is spatially unique.

Stratified Random Sampling

Stratified random sampling may be useful when distinct strata or "homogeneous sub-groups" are identified within the population. The strata could be located in different areas of the population, or the strata may be comprised of different layers. This approach is useful when the individual strata may be considered internally homogeneous, or at least have less internal variation, in what would otherwise be considered a heterogeneous population. Information on the site is usually required to establish the location of individual strata. A grid may be utilized for sampling several horizontal layers if the strata are horizontally oriented. A simple random sampling approach is typically utilized for sample collection within each strata. The use of a stratified random sampling strategy may result in the collection of fewer samples.

Systematic Grid Sampling

Systematic grid sampling involves the collection of samples at fixed intervals when the contamination is assumed to be randomly distributed. This method is commonly used with populations when estimating trends or patterns of contamination. This approach may not be acceptable if the entire population is not accessible, or if the systematic plan becomes "phased" with variations in the distribution of contaminants within the matrix. This approach may also be useful for identifying the presence of strata within the population. The grid and starting points should be randomly laid out over the site, yet the method allows for rather easy location of exact sample locations within each grid. Also, the grid size would typically be adjusted according to the number of samples that are required.

Appendix C

Standard Operating Procedures

Appendix D

Field Decontamination Procedures

STANDARD FIELD DECONTAMINATION PROCEDURES

D.1.0 Introduction

These procedures are intended for use by field personnel for cleaning sampling and other equipment in the field. Emergency field sample container cleaning procedures are also included; however, they should not be used unless absolutely necessary.

Sampling and field equipment cleaned in accordance with these procedures must meet the minimum requirements for Data Quality Objectives (DQO) definitive data collection. Deviations from these procedures should be documented in the approved study plan, field records, and investigative reports.

These are the materials, methods, and procedures to be used when cleaning sampling and other equipment in the field.

D.1.1 Specifications for Cleaning Materials

Specifications for standard cleaning materials referred to in this appendix are as follows:

- Soap shall be a standard brand of phosphate-free laboratory detergent such as Liquinox®. Use of other detergent must be justified and documented in the field logbooks and inspection or investigative reports.

- Solvent shall be pesticide-grade isopropanol. Use of a solvent other than pesticide-grade isopropanol for equipment cleaning purposes must be justified in the study plan. Otherwise its use must be documented in field logbooks and inspection or investigation reports.

- Tap water may be used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

- Analyte free water (deionized water) is tap water that has been treated by passing through a standard deionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard inductively coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. Analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

- Organic/analyte free water is defined as tap water that has been treated with activated carbon and deionizing units. A portable system to produce organic/analyte free water under field conditions is available. At a minimum, the finished water must meet the analytical criteria of analyte free water and should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels. Organic/analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

- Other solvents may be substituted for a particular purpose if required. For example, removal of concentrated waste materials may require the use of either pesticide-grade hexane or petroleum ether. After the waste material is removed, the equipment must be subjected to the standard cleaning procedure. Because these solvents are not miscible with water, the equipment must be completely dry prior to use.

Solvents, laboratory detergent, and rinse waters used to clean equipment shall not be reused during field decontamination.

D.1.2 Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. Following are acceptable materials used for containing the specified cleaning solutions:

- <u>Soap</u> must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.

- <u>Solvent</u> must be stored in the unopened original containers until used. They may be applied using the low-pressure nitrogen system fitted with a Teflon® nozzle, or using Teflon® squeeze bottles.

- <u>Tap water</u> may be kept in clean tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.

- <u>Analyte free water</u> must be stored in clean glass, stainless steel, or plastic containers that can be closed prior to use. It can be applied from plastic squeeze bottles.

- <u>Organic/analyte free water</u> must be stored in clean glass, Teflon®, or stainless steel containers prior to use. It may be applied using Teflon® squeeze bottles, or with the portable system.

Note: Hand pump sprayers generally are <u>not</u> acceptable storage or application containers for the above materials (with the exception of tap water). This also applies to stainless steel sprayers. All hand sprayers have internal oil coated gaskets and black rubber seals that may contaminate the solutions.

D.1.3 Disposal of Solvent Cleaning Solutions

Procedures for the safe handling and disposition of investigation derived waste (IDW), including used wash water, rinse water, and spent solvents will be developed as required.

D.1.4 Equipment Contaminated with Concentrated Wastes

Equipment used to collect samples of hazardous materials or toxic wastes or materials from hazardous waste sites, RCRA facilities, or in-process waste streams should be field cleaned before returning from the study. At a minimum, this should consist of washing with soap and rinsing with tap water. More stringent procedures may be required at the discretion of the field investigators.

D.1.5 Safety Procedures for Field Cleaning Operations

Some of the materials used to implement the cleaning procedures outlined in this appendix can be harmful if used improperly. Caution should be exercised by all field investigators and all applicable safety procedures should be followed. At a minimum, the following precautions should be taken in the field during these cleaning operations:

- Safety glasses with splash shields or goggles, and latex gloves will be worn during all cleaning operations.
- Solvent rinsing operations will be conducted in the open (never in a closed room).
- No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted during cleaning operations.

D.1.6 Handling of Cleaned Equipment

After field cleaning, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the cleaning area to prevent recontamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

D.2.0 Field Equipment Cleaning Procedures

Sufficient clean equipment should be transported to the field so that an entire study can be conducted without the need for field cleaning.

However, this is not possible for some specialized items such as portable power augers (Little Beaver®), well drilling rigs, soil coring rigs, and other large pieces of field equipment. In addition, particularly during large-scale studies, it is not practical or possible to transport all of the pre-cleaned field equipment required into the field.

In these instances, sufficient pre-cleaned equipment should be transported to the field to perform at least one days work. The following procedures are to be utilized when equipment must be cleaned in the field.

D.2.1 Specifications for Decontamination Pads

Decontamination pads constructed for field cleaning of sampling and drilling equipment should meet the following minimum specifications:

- The pad should be constructed in an area known or believed to be free of surface contamination.
- The pad should not leak excessively.
- If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined.

- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above ground to prevent equipment from being splashed.

- Water should be removed from the decontamination pad frequently.

- A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced (disposable) or repairable.

At the completion of site activities, the decontamination pad should be deactivated. The pit or sump should be backfilled with the appropriate material designated by the site project leader, but only after all waste/rinse water has been pumped into containers for disposal. No solvent rinsates will be placed in the pit. Solvent rinsates should be collected in separate containers for proper disposal. If the decontamination pad has leaked excessively, soil sampling may be required.

D.2.2 "Classic Parameter" Sampling Equipment

"Classic Parameters" are analyses such as oxygen demand, nutrients, certain inorganics, sulfide, flow measurements, etc.

For routine operations involving classic parameter analyses, water quality sampling equipment such as Kemmerers, buckets, dissolved oxygen dunkers, dredges, etc., may be cleaned with the sample or analyte-free water between sampling locations. A brush may be used to remove deposits of material or sediment, if necessary. If analyte-free water is samplers should be flushed at the next sampling location with the substance (water) to be sampled, but before the sample is collected.

Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gaging equipment may be cleaned with tap water between measuring locations, if necessary.

The previously described procedures are not to be used for cleaning field equipment to be used for the collection of samples undergoing trace organic or inorganic constituent analyses.

D.2.3 Sampling Equipment used for the Collection of Trace Organic and Inorganic Compounds

The following procedures are to be used for all sampling equipment used to collect routine samples undergoing trace organic or inorganic constituent analyses:

1. Clean with tap water and soap using a brush if necessary to remove particulate matter and surface films. Equipment may be steam cleaned (soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.

2. Rinse thoroughly with tap water.

3. Rinse thoroughly with analyte free water.

4. Rinse thoroughly with solvent. Do not solvent rinse PVC or plastic items.

5. Rinse thoroughly with organic/analyte free water. If organic/analyte free water is not available, equipment should be allowed to completely dry. Do not apply a final rinse with analyte water. Organic/analyte free water can be generated on-site utilizing the portable system.

6. Remove the equipment from the decontamination area and cover with plastic. Equipment stored overnight should be wrapped in aluminum foil and covered with clean, unused plastic.

D.2.4 Well Sounders or Tapes

1. Wash with soap and tap water.

2. Rinse with tap water.

3. Rinse with analyte free water.

D.2.5 Fultz® Pump Cleaning Procedure

CAUTION - To avoid damaging the Fultz® pump:

Never run pump when dry

Never switch directly from the forward to the reverse mode without pausing in the "OFF" position

The Fultz® pump should be cleaned prior to use and between each monitoring well. The following procedure is required:

1. Pump a sufficient amount of soapy water through the hose to flush out any residual purge water.

2. Using a brush, scrub the exterior of the contaminated hose and pump with soapy water. Rinse the soap from the outside of the hose with tap water. Rinse the hose with analyte-free water and recoil onto the spool.

3. Pump a sufficient amount of tap water through the hose to flush out all the soapy water (approximately one gallon).

4. Pump a sufficient amount of analyte-free water through the hose to flush out the tap water, then purge with the pump in the reverse mode.

5. Rinse the outside of the pump housing and hose with analyte-free water (approximately 1/4 gal.).

6. Place pump and reel in clean plastic bag.

D.2.6 Goulds® Pump Cleaning Procedure

CAUTION - During cleaning always disconnect the pump from the generator.

The Goulds© pump should be cleaned prior to use and between each monitoring well.

The following procedure is required:

1. Using a brush, scrub the exterior of the contaminated hose and pump with soap and tap water.
2. Rinse the soap from the outside of the pump and hose with tap water.
3. Rinse the tap water residue from the outside of pump and hose with analyte-free water.
4. Place the pump and hose in a clean plastic bag.

D.2.7 Redi-Flo2® Pump

The Redi-Flo2® pump should be cleaned prior to use and between each monitoring well. The following procedure is required:

CAUTION - Make sure the pump is not plugged in.

1. Using a brush, scrub the exterior of the pump, electrical cord and garden hose with soap and tap water. Do not wet the electrical plug.
2. Rinse with tap water.
3. Rinse with analyte free water.
4. Place the equipment in a clean plastic bag.

To clean the Redi-Flo2® ball check valve:

1. Completely dismantle ball check valve. Check for wear and/or corrosion, and replace as needed.
2. Using a brush, scrub all components with soap and tap water.
3. Rinse with analyte free water.
4. Reassemble and re-attach the ball check valve to the Redi-Flo2® pump head.

D.2.8 Automatic Sampler Tubing

The Silastic® and Tygon® tubing previously used in the automatic samplers may be field cleaned as follows:

1. Flush tubing with tap water and soap.
2. Rinse tubing thoroughly with tap water.
3. Rinse tubing with analyte free water.

D.3.0 Downhole Drilling Equipment

These procedures are to be used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses, and for the construction of monitoring wells to be used for the collection of groundwater samples for trace organic and inorganic constituent analyses.

D.3.1 Introduction

Cleaning and decontamination of all equipment should occur at a designated area (decontamination pad) on the site. The decontamination pad should meet the specifications of Section D.2.1.

Tap water (potable) brought on the site for drilling and cleaning purposes should be contained in a pre-cleaned tank of sufficient size so that drilling activities can proceed without having to stop and obtain additional water.

A steam cleaner and/or high pressure hot water washer capable of generating a pressure of at least 2500 PSI and producing hot water and/or steam (200° F plus), with a soap compartment, should be obtained.

D.3.2 Preliminary Cleaning and Inspection

The drill rig should be clean of any contaminants that may have been transported from another hazardous waste site, to minimize the potential for cross-contamination. Further, the drill rig itself should not serve as a source of contaminants. In addition, associated drilling and decontamination equipment, well construction materials, and equipment handling procedures should meet these minimum specified criteria:

- All downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam cleaning (soap and high pressure hot water), or wire brushing. Sandblasting should be performed prior to arrival on site, or well away from the decontamination pad and areas to be sampled.

- Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) and wire brushed (as needed) to remove all rust, soil, and other material which may have come from other hazardous waste sites before being brought on site.

- Printing and/or writing on well casing, tremie tubing, etc. should be removed before use. Emery cloth or sand paper can be used to remove the printing and/or writing. Most well material suppliers can supply materials without the printing and/or writing if specified when ordered.

- The drill rig and other equipment associated with the drilling and sampling activities should be inspected to insure that all oils, greases, hydraulic fluids, etc., have been removed, and all seals and gaskets are intact with no fluid leaks.

- PVC or plastic materials such as tremie tubes should be inspected. Items that cannot be cleaned are not acceptable and should be discarded.

D.3.3 Drill Rig Field Cleaning Procedure

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) between boreholes.

D.3.4 Field Cleaning Procedure for Drilling Equipment

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does <u>not</u> apply to well casings, well screens, or split-spoon samplers used to obtain samples for chemical analyses, which should be cleaned as outlined in Section D.2.3.

1. Clean with tap water and soap, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high-pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.

2. Rinse thoroughly with tap water.

3. Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place.

When there is concern for low level contaminants it may be necessary to clean this equipment between borehole drilling and/or monitoring well installation using the procedure outlined in Section D.2.3.

D.4.0 Emergency Disposable Sample Container Cleaning

New one-pint or one-quart mason jars may be used to collect samples for analyses of organic compounds and metals in waste and soil samples during an emergency. These containers would also be acceptable on an emergency basis for the collection of water samples for extractable organic compounds, pesticides, and metals analyses. These jars cannot be used for the collection of water samples for volatile organic compound analyses.

The rubber sealing ring should not be in contact with the jar and aluminum foil should be used, if possible, between the jar and the sealing ring.

If possible, the jar and aluminum foil should be rinsed with pesticide-grade isopropanol and allowed to air dry before use. Several empty bottles and lids should be submitted to the laboratory as blanks for quality control purposes.

Document Control #: 07-DCN-00

STANDARD OPERATING PROCEDURE FOR SAMPLING EQUIPMENT AND CONTAINER DECONTAMINATION

Issue Date: November 8, 2004
Revision 00

Last Review/Implementation Date: November 2004

KEMRON Environmental Services

8150 Leesburg Pike, Suite 1410, Vienna, VA 22182 (Vienna)
1359-A Ellsworth Industrial Blvd, Atlanta, GA 30318 (Atlanta)
156 Starlite Drive, Marietta, OH 45750 (Lab and Marietta)
#5 Craddock Way, Rock Branch Industrial Park, Poca, WV 25159 (Charleston)
3155 Black Hawk Drive, Building 379, Fort Sheridan, IL 60037 (Chicago)

Approved by:

Marilyn K. Zumbro

11/8/04

Marilyn Zumbro, Regional Manager — Date

11/8/04

John Dwyer, Vice President — Date

Kelly Clemons

11/8/04

Kelly Clemons, Corporate Quality Assurance Manager — Date

The following persons have read and understand this SOP:

Signature	Date

TABLE OF CONTENTS

1. PURPOSE

By complying with procedures specified in this SOP, KEMRON will ensure the removal of contaminants of concern from sampling, drilling and other field equipment.

2. SCOPE

This procedure provides technical guidance on decontamination of sampling equipment and sample containers. The following two categories of cleaning are covered in this procedure:

- Equipment cleaning procedures
- Emergency field sample container cleaning

3. RESPONSIBILITIES

3.1 Project Manager Responsibilities

The KEMRON project manager ensures that any project specific deviations from this procedure will be provided to the Field Staff.

3.2 Field Staff Responsibilities

The KEMRON field staff follow procedures specified in this SOP unless written site-specific protocol is provided by the Project Manager.

4. DEFINITIONS / SPECIFICATIONS

4.1 Emergency Field Sample Container Cleaning Procedures

Emergency field sample container cleaning procedures are restricted procedures to be used when events occur outside the scope of the sampling plan.

4.2 Soap

Soap is a standard brand of phosphate-free laboratory detergent such as Liquinox®. Use of other detergent is justified and documented in the field logbooks and inspection or investigative reports.

4.3 Solvent

Solvent is pesticide-grade isopropanol. Other solvents may be substituted for a particular purpose if required. Pesticide-grade acetone or methanol are acceptable.

4.4 Tap water

Tap water may be used from any municipal water treatment system (spigot at the office). Use of an untreated potable water supply is not an acceptable substitute for tap water.

4.5 Deionized water

Deionized water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits).

4.6 Disinfectant soap
Disinfectant soap is a standard brand of disinfectant cleaner.

4.7 Nitric acid solution (10%)
Nitric acid solution (10%) is made from reagent-grade nitric acid and deionized water.

4.8 Containment
Containment includes securing all waste materials generated during site operations. Routine practice should include all efforts to keep used decontamination solutions at the site. This is especially the case for equipment used to collect samples of hazardous materials or toxic wastes or materials from hazardous waste sites or RCRA facilities.

5. HANDLING OF AND CONTAINERS FOR CLEANING SOLUTIONS

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. The following are acceptable materials used for containing the specified cleaning solutions:

5.1 Standard Use Solutions

5.1.1 Soap is kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.

5.1.2 Tap water may be kept in clean tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose. All secondary containers are labeled as to the contents.

5.1.3 Deionized water is stored in clean containers that can be closed prior to use. It can be applied from plastic squeeze bottles. All secondary containers are labeled as to the contents.

5.2 Non-standard Use Solutions

5.2.1 Disinfectant soap should be kept in clean containers until use. It should be poured directly from the container.

5.2.2 Solvent is stored in the unopened original containers until used. They may be applied using the low pressure nitrogen system fitted with a Teflon® nozzle, or using Teflon® squeeze bottles. All secondary containers are labeled as to the contents.

5.2.3 Nitric acid should be kept in the glass container it is received in, and placed in squeeze bottles prior to application. All secondary containers are labeled as to the contents.

Note: Hand pump sprayers generally are not acceptable storage or application containers for the above materials (with the exception of tap water). This also applies to stainless steel sprayers. All hand sprayers have internal oil coated gaskets and black rubber seals that may contaminate the solutions.

6. EQUIPMENT CLEANING PROCEDURES

All equipment taken to the field is assumed to be clean. The following procedures are completed during a sampling event for multiple uses of the equipment, at the conclusion of equipment use at the site and if visual evidence indicates a need at the onset of equipment use.

6.1 Specifications for Decontamination Pads

The size of the project will dictate the method of containing decontamination fluids. Examples of containment include the use of drums, buckets, decon pads, etc. For additional information see Appendix C.

6.2 Sampling Equipment Cleaning Procedures

The following procedures are used for all sampling equipment (well casings, well screens, or split spoon samplers, etc.), unless otherwise specified in the project documents or unless it is observed that additional cleaning is necessary. For additional guidance on decontamination and cleaning of equipment, see Appendix A.

1) Clean with tap water and soap using a brush if necessary to remove particulate matter and surface films. Equipment may be steam cleaned (soap and high pressure hot water) as an alternative to brushing; however, PVC or plastic items should not be steam cleaned.
2) Rinse thoroughly with tap water.
3) Rinse thoroughly with deionized water.
4) If equipment is to be used during the next field sampling operations, remove from the decontamination area and cover with plastic. If equipment cleaning is a final project cleaning or will be used during a later sampling phase, wrap equipment in one layer of aluminum foil. Seal the foil wrapped equipment in plastic and label.
5) For information related to contaminant of decontamination solutions, see Appendix F.

After collecting samples that contain oil, grease, or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone, hexane or petroleum either to remove the materials before proceeding with the first step of cleaning; or in extreme cases, it may be necessary to steam clean the field equipment before the first step of cleaning; or discarding the equipment may be necessary. Special considerations need to be addressed with the Project Manager before deciding to use solvent rinses since waste handling and disposal are regulated activities.

6.3 Cleaning Procedures for Specialized Equipment

For specialized field equipment the manufacturer's manual should state the cleaning procedures KEMRON should use. For additional information see Appendix A.

6.4 Handling of Cleaned Equipment

After field cleaning, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the cleaning area to prevent recontamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

7. SUBCONTRACTOR EQUIPMENT CLEANING PROCEDURES

Heavy equipment rental and operation is usually subcontracted and the subcontractor is responsible for equipment decontamination. KEMRON personnel are responsible to direct any additional cleaning should there be a need. For additional information see Appendix D.

8. EQUIPMENT CLEANING PROCEDURES AT THE OFFICE

Additional cleaning and decontamination procedures maybe warranted when equipment or parts of equipment arrival back at the office (field or home). See Appendix B for examples of cleaning procedures and Appendix G for disposal of office cleaning solutions.

9. PROCEDURES FOR DISPOSABLE SAMPLE CONTAINER CLEANING AND USE: IN EMERGENCY FIELD SITUATIONS

The following container use and cleaning procedures are restricted for use in emergency situations only which maybe necessary if sampling occurs outside planned events; or in the case of an ER mobilization where additional containers may be needed in a pinch. In such emergencies, new one-pint or one-quart mason jars may be used to collect samples for analyses of organic compounds and metals in waste and soil samples. These containers would also be acceptable on an emergency basis for the collection of water samples for extractable organic compounds, pesticides, and metals analyses. These jars cannot be used for the collection of water samples for volatile organic compound analyses. The rubber sealing ring should not be in contact with the jar and aluminum foil should be used, if possible, between the jar and the sealing ring. If possible, the jar and aluminum foil should be rinsed with pesticide-grade isopropanol and allowed to air dry before use. Several empty bottles and lids maybe submitted to the laboratory as blanks for quality control purposes.

10. PREPARATION OF DISPOSABLE SAMPLE CONTAINERS

Routine sampling procedures call for precleaned containers supplied by the laboratory. However, if disruption of the supply of pre-cleaned, certified sample bottles occurs, sampling may have to continue regardless. In such situations, the laboratory is contacted immediately for the shipping of additional containers and approval of any field cleaning procedures of sample containers in the interim. For examples of cleaning disposable sample containers under such conditions, see Appendix E.

11. REFERENCE

1) Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, US EPA Region 4, November 2001

APPENDIX A: ADDITIONAL FIELD CLEANING PROCEDURES

Well Sounders, Tapes, or Interface Probes

The following cleaning procedures are used for well sounders or tapes:

1) Wash with soap and tap water.
2) Rinse with tap water.
3) Rinse with deionized water.

Pumps

Cleaning of pumps not specified in this section will be cleaned in a similar fashion.

1) Goulds® Pump Cleaning Procedure
   CAUTION - During cleaning always disconnect the pump from the generator. The Goulds© pump should be cleaned prior to use and between each monitoring well. The following cleaning procedure is used:
   a) Using a brush, scrub the exterior of the contaminated hose and pump with soap and tap water.
   b) Rinse the soap from the outside of the pump and hose with tap water.
   c) Rinse the tap water residue from the outside of pump and hose with deionized water.
   d) Place the pump and hose in a clean plastic bag.

2) Redi-Flo2® Pump
   CAUTION - Make sure the pump is not plugged in. The Redi-Flo2® pump should be cleaned prior to use and between each monitoring well. The following cleaning procedure is used:
   a) Using a brush, scrub the exterior of the pump, electrical cord and garden hose with soap and tap water. Do not wet the electrical plug.
   b) Rinse with tap water.
   c) Rinse with deionized water.
   d) Place the equipment in a clean plastic bag.

3) Redi-Flo2® Ball Check Valve
   The following procedure is required to clean the Redi-Flo2® ball check valve:
   a) Completely dismantle ball check valve. Check for wear and/or corrosion, and replace as needed.
   b) Using a brush, scrub all components with soap and tap water.
   c) Rinse with deionized water.
   d) Reassemble and re-attach the ball check valve to the Redi-Flo2® pump head.

Automatic Sampler Tubing

Whenever possible use new or dedicated tubing. In cases where new or dedicated tubing can not be used, Silastic® and Tygon® tubing previously used in the automatic samplers may be field cleaned as follows:

a) Flush tubing with tap water and soap.
b) Rinse tubing thoroughly with tap water.
c) Rinse tubing with deionized water.

Full-face, ½-face, and SCBA Face-masks

When there is a potential for exposure, face masks are used. This being the case, cleaning of face masks always follows use.

a) Wash face-mask thoroughly inside and out with hot tap water and disinfectant soap. Use only soft brushes. Do not use scouring pads of any type.
b) Rinse face-mask thoroughly inside and out with tap water.
c) Hang face-mask up until completely dry.
d) Place face-mask in plastic bag and return to SCBA case.

APRs are completely dismantled prior to cleaning. Then steps as outlined above for SCBA face masks are used. When completely dry, the APR is reassembled and placed in a plastic bag.

APPENDIX B: PROCEDURES FOR OFFICE CLEANING

See the web at the following web address for additional cleaning procedures (see reference section): http://www.epa.gov/region4/sesd/eisopqam/eisopqam.pdf

APPENDIX C: EXAMPLE OF CONSTRUCTION & USE OF A DECONTAMINATION PAD

1) The pad should be constructed in an area known or believed to be free of surface contamination.
2) The pad should not leak excessively.
3) If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined.
4) Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above ground to prevent equipment from being splashed.
5) Water should be removed from the decontamination pad frequently.
6) A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced (disposable) or repairable.
7) At the completion of site activities, the decontamination pad should be deactivated. The pit or sump should be backfilled with the appropriate material designated by the site project leader, but only after all waste/rinse water has been pumped into containers for disposal. No solvent rinsates will be placed in the pit.
8) Solvent rinsates should be collected in separate containers for proper disposal. If the decontamination pad has leaked excessively, soil sampling may be required.

APPENDIX D: SUBCONTRACTOR EQUIPMENT CLEANING PROCEDURES

This section is provided as a guide to KEMRON employees to ensure that the subcontractor equipment brought on-site and cleaned in the field has been cleaned to a level equivalent to that stated here. In addition, the procedures stated provide an example of text that should be included in the SOW the subcontractor is to follow where it is specified that such steps are to be completed either prior to arrival at the site or between each drilling event, as applicable.

These procedures are used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses, and for the construction of monitoring wells to be used for the collection of groundwater samples for trace organic and inorganic constituent analyses.

Preliminary Equipment Cleaning (prior to site arrival)

The subcontractor should bring drilling and related equipment pre-cleaned and ready for use. The following outlines the equivalent procedures that should be used by the subcontractor:

1) All downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam cleaning (soap and high pressure hot water), or wire brushing. Sandblasting should be performed prior to arrival on site, or well away from the decontamination pad and areas to be sampled.
2) Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) and wire brushed (as needed) to remove all rust, soil, and other material which may have come from other hazardous waste sites before being brought on site.
3) Printing and/or writing on well casing, tremie tubing, etc., should be removed before use. Emery cloth or sand paper can be used to remove the printing and/or writing. Most well material suppliers can supply materials without the printing and/or writing if specified when ordered.

Drill Rig Field Cleaning Procedure for Multiple Boreholes

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) between boreholes.

Field Cleaning Procedure for Drilling Equipment

The following is a standard procedure for subcontractor field cleaning of augers, drill stems, rods, tools, and associated equipment.

1) Clean with tap water and soap, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.
2) Rinse thoroughly with tap water.
3) Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place.

APPENDIX E: PREPARATION OF DISPOSABLE SAMPLE CONTAINERS

1. Introduction
   No disposable sample container (with the exception of the glass and plastic compositing containers) may be reused. All disposable sample containers will be stored in their original packing containers. When packages of uncapped sample containers are opened, they will be placed in new plastic garbage bags and sealed to prevent contamination during storage. Specific pre-cleaning instructions for disposable sample containers are given in the following sections.

2. Plastic Containers used for "Classical" Parameters
   Plastic containers used for oxygen demand, nutrients, classical inorganics, and sulfides have no precleaning requirement. However, only new containers may be used.

3. Glass Bottles for Semi-Volatile GC/MS Analytes
   These procedures are to be used only if the supply of pre-cleaned, certified sample bottles is disrupted. Laboratory approval is necessary prior to implementation of these procedures. If desired, pesticide-grade methylene chloride may be substituted for pesticide-grade isopropanol. In addition, 1:1 nitric acid may be substituted for the 10% nitric acid solution.

   a) Wash bottles and jars, Teflon® liners, and caps in hot tap water and soap.
   b) Rinse three times with tap water.
   c) Rinse with 10% nitric acid solution.
   d) Rinse three times with deionized water.
   e) Rinse bottles, jars, and liners (not caps) with solvent.
   f) Oven dry bottles, jars, and liners at 125EC. Allow to cool.
   g) Place liners in caps and close containers.
   h) Store in contaminant-free area.

4. Glass Bottles for Volatile GC/MS and TOX Analyses
   These procedures are to be used only if the supply of pre-cleaned, certified sample bottles is disrupted. Prior QA approval is necessary prior to implementation of these procedures.
   a) Wash vials, bottles and jars, Teflon liners and septa, and caps in hot tap water and laboratory detergent.
   b) Rinse all items with deionized water.
   c) Oven dry at 125oC and allow to cool.
   d) Seal vials, bottles, and jars with liners or septa as appropriate and cap.
   e) Store in a contaminant free area.

5. Plastic Bottles for ICP Analytes
   These procedures are to be used only if the supply of pre-cleaned, certified sample bottles is disrupted. Prior QA approval is necessary prior to implementation of these procedures.
   a) Wash bottles and caps in hot tap water with soap.
   b) Rinse both with 10% nitric acid solution.
   c) Rinse three times with deionized water.
   d) Invert bottles and dry in contaminant free environment.
   e) Cap bottles.
   f) Store in contaminant free area.

APPENDIX F: DISPOSAL OF FIELD CLEANING SOLUTIONS

Disposal of Field Cleaning Solutions
Procedures for the safe handling and disposition of investigation derived waste (IDW), including used wash water, rinse water, and spent solvents are specified in the project plan. The following are provided as general guidelines:

1) Minimum Requirements for Non-hazardous Disposal of IDW
   a) Liquid and soil/sediment IDW is containerized and analyzed before disposal.
   b) The collection, handling, and proposed disposal method is specified in the approved project plan.

2) Minimum Requirements for Management of Hazardous IDW
   a) Spent solvents should remain in the field for proper disposal or recycling.
   b) All hazardous IDW is containerized. Proper handling and disposal should be arranged prior to commencement of field activities.

DISPOSAL of IDW

Type	Hazardous	Non-Hazardous
Spent Solvents	Containerize in original containers. Clearly identify contents. Leave on-site with permission of site operator, otherwise return to field office for proper disposal.	N/A
Decontamination Water	Containerize in 55-gallon drum with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with site manager for testing and disposal.	Containerize in 55-gallon drum with tight fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with site manager for testing and disposal.

APPENDIX G: DISPOSAL OF OFFICE (FIELD OR HOME) CLEANING SOLUTIONS

Since equipment is cleaned in the field at the conclusion of field activities, any additional cleaning completed at the office will have differing waste disposal procedures for cleaning solutions than those in the field. Procedures for safe handling and disposition of such spent cleaning solutions, including washwater, rinse water, spent acid solutions, and spent solvents are as follows:

1) Washwater
   Since equipment is decontaminated before its return to the office, the washwater may be disposed in the sanitary drain in the washroom. When large equipment (vehicles, augers, etc.) is washed outside, it may wash onto the ground without recovery of the washwater.

2) Rinsewater
   Since equipment is decontaminated before its return to the office, the rinsewater may be disposed in the sanitary drain in the washroom. When large equipment (vehicles, augers, etc.) is rinsed outside, it may go onto the ground without recovery.

3) Nitric Acid
   Nitric acid cleaning solutions are to be diluted to a pH greater than 2.0, and flushed down the sanitary drain in the washroom. If used outdoors, this material should be captured and diluted to a pH greater than 2.0, and flushed down the sanitary drain in the washroom.

4) Solvent
   All solvents used should be captured, properly labeled, and stored on the premises of the office until arrangements for proper disposal are made. Used solvents can be classified as either "solvent for recovery" or "solvent for disposal". Solvent for recovery is that which was used in the standard field cleaning or office cleaning of equipment. Solvent used for cleaning badly contaminated equipment (e.g., tar removal, etc.) should be designated for disposal. The two groups should be labeled "For Recovery" or "For Disposal" and stored separately at the office.

Document Control #: 08-VES-00

STANDARD OPERATING PROCEDURE FOR LARGE VESSEL SAMPLING

Issue Date: November 8, 2004
Revision 00

Last Review/Implementation Date: November 2004

KEMRON Environmental Services

8150 Leesburg Pike, Suite 1410, Vienna, VA 22182 (Vienna)
1359-A Ellsworth Industrial Blvd, Atlanta, GA 30318 (Atlanta)
156 Starlite Drive, Marietta, OH 45750 (Lab and Marietta)
#5 Craddock Way, Rock Branch Industrial Park, Poca, WV 25159 (Charleston)
3155 Black Hawk Drive, Building 379, Fort Sheridan, IL 60037 (Chicago)

Approved by:

Marilyn K. Zumbro

Marilyn Zumbro, Regional Manager — 11/8/04 Date

John Dwyer, Vice President — 11/8/04 Date

Kelly McClemons

Kelly Clemons, Corporate Quality Assurance Manager — 11/8/04 Date

The following persons have read and understand this SOP:

Signature	Date

TABLE OF CONTENTS

1. POLICY

The primary objective of all KEMRON personnel conducting environmental sampling is the collection of representative samples. Representative sampling can be achieved by establishing a comprehensive set of standard operating procedures to be followed by all personnel responsible for the collection of samples. KEMRON personnel will follow procedures established in the "SOP for Large Vessel Sampling" unless site specific protocol is provided by the client. Personnel will follow all Health and Safety procedures as directed by the Corporate Health and Safety Plan and the Site Specific Health and Safety Plan.

2. PURPOSE

This procedure provides technical guidance for vessel sampling. The objectives for this SOP include the following:

- To determine the various physical states of material present in the vessel
- To obtain a sample of each layer
- To correctly log all relevant information about the vessel contents and origins

By complying with procedures specified in the SOP, KEMRON will ensure that the following are successfully completed:

1. Prevent contamination or cross-contamination of samples during collection, containerization, transit and storage.
2. Obtain and record accurate and complete sampling data.
3. Prepare complete and correct sample labels.
4. Maintain sample chain-of-custody.

3. SCOPE

This procedure addresses steps to open and sample vessels such as tanks, vats, pits and troughs.

4. RESPONSIBILITIES

4.1 Project Manager Responsibilities

The KEMRON Project Manager ensures vessel sampling is completed as stated in this SOP or any site-specific procedures.

4.2 Field Staff Responsibilities

The KEMRON Field Staff prepares, organizes, and inspects all equipment required for the sampling event prior to the initiation of sampling activities. Upon completion of the sampling event, the Field Staff returns all equipment to the designated storage area ensuring that the equipment is decontaminated and in a condition ready for reuse. KEMRON Field Staffs are required to follow procedures specified in this SOP unless written site-specific protocol is provided by the Project Manager prior to initiating the sampling event. Deviations from this SOP require prior written approval from the KEMRON Project Manager or his designated alternate.

5. DEFINITIONS

5.2 Vessel Sampling Equipment

5.1.1 Composite Liquid Waste Sampler (Coliwasa) -see Figure 1

A glass tube with a central rod designed to capture liquids present in a vessel.

5.1.2 Glass Thief (see Figure 2)

A glass or polypropylene tube designed to sample liquid portions of various vessels.

5.1.3 Sample Scoop

A metal, polyethylene or polypropylene scoop designed to sample solid sludge and gel-like portions of vessels.

5.1.4 Sludge Judge® (see Figure 3)

A butyrate plastic tube used to sample the contents of a tank (AST or UST), tanker, sludge pit, vat or other difficult to sample vessels. The bottom end of the apparatus contains a ball and cock. Additional sections without ball and cock devices can be attached to achieve the full depth of the vessel to be sampled. Each section is graduated to allow for measurement of vessel and content depth.

5.3 Lower Explosive Limit (LEL)

The lowest concentration of a vapor in air that could cause a fire if an ignition source is present.

5.4 Monitoring Equipment

5.3.1 Photo Ionization Detector (PID)

An instrument that contains a detector which measures the ionic potential of chemical vapors in the air. It is best used for monitoring organic vapors at the sampling point of a vessel. This instrument is best used for detecting unsaturated hydrocarbons especially aromatics (i.e. benzene, toluene).

5.3.2 Flame Ionization Detector (FID)

An instrument that contains a detector which measures the breaking of a carbon-hydrogen bond by a flame. Since organic compounds are commonly referred to as hydrocarbons, this detector is best used for detecting all organic vapors encountered during sampling activities.

5.3.3 LEL Meter

An instrument designed to measure the percentage (%) of the LEL of chemical vapors in air. Meters to measure LEL are most commonly known as O2/LEL meters (can also measure oxygen levels in the atmosphere), and 4-Gas meters (can measure oxygen, hydrogen sulfide and carbon monoxide levels in the atmosphere).

5.5 Non-sparking Tools
Metal tools used for gaining access to various vessels that are made of certain metals that do not spark when in contact with stainless steel or aluminum vessels. Beryllium is an example.

5.6 Unknown Vessel
Any vessel which does not have any of the following information: client (or other reliable source) supplied information related to the contents of the vessel; or laboratory data indicating the contents of the vessel; or label(s) affixed to the vessel indicating contents.

6. PLANNING

The Project Manager includes any project-specific information in written instructions for the sampling crew. Written instructions can be as simple as a Sampling Requirements report or as detailed as a Sampling and Analysis Plan. Written sampling instructions may include the following:

a) Sample point identification - sampling locations, ID names, or numbers to be sampled.
b) Site map with sampling/vessel locations clearly marked.
c) Sampling equipment requirements.
d) Sampling point accessibility and vehicle requirements.
e) Required constituents for each sampling point.
f) Sample holding times, preservation methods, and analytical method requirements.
g) Sample analyte collection order.
h) Required QA/QC samples: Equipment Blanks, Trip Blanks, Field Duplicates, Field Blanks, and Laboratory QC samples.
i) Documentation requirements including chain of custody, labeling, field data sheets, etc.

7. TANK AND VAT SAMPLING

7.1 Determine access points.
7.2 Open access port by hand or by using non sparking tools.
7.3 Complete a Radioactive Survey.
Hold the dosimeters approximately 2 inches from the opening and record the equilibrated reading. Any readings that exceed 2 mrem/hr should be considered highly radioactive.
7.4 Take LEL readings.
7.5 Take Organic Vapor Readings
Hold the PID/FID probe at the opening but not inside the vessel. Record the highest reading.
7.6 Sampling with a Sludge Judge®
7.6.1 Add extensions.
7.6.2 Gently move the apparatus up and down.
7.6.3 Shake vigorously to sample sludges and to properly seat the ball at the bottom.
7.6.4 Slowly begin to withdraw the Sludge Judge®.
7.6.5 Remove the extensions that were not in contact with sample matrix.

7.6.6 Continue to withdraw the Sludge Judge® while wiping off the outside using absorbent pads or towels.
7.6.7 Record layer depths in inches and total depth collected in inches.
7.6.8 Transfer the bottom layer into a pre-cleaned sample container(s) and then discard the remainder of the layer. Each layer should be a separate sample.
7.6.9 Cap the sample container tightly, label and record in the Drum / Vessel Inventory Log.
7.6.10 Close the sample port.
7.6.11 Transport sample to the decontamination zone.

7.7 Calculate and Record Tank and Layer Volume
7.7.1 Determine total and layer volume directly from a graduated tank or vat.
7.7.2 Determine by calculation
7.7.2.1 Round or conical in shape
a) Measure the circumference to determine the radius (circumference = $2\Pi r$ where r is the radius).
b) Calculate the amount of sample volume (in cubic feet-ft3) using the formula $V=\Pi r^2 h$ where r is the radius and h is the height (depth) (in feet) of the product layer. This formula can be used only if the tank is uniformly round throughout the product layer.
c) Convert to gallons by multiplying the volume in cubic feet by 7.48.
d) If the bottom of the tank is conical, calculate by the formula $V= 1/3*r^2h$. This portion's volume can be added to the uniformly round portion.
e) Add all layer volumes for total volume in vessel.

7.7.2.2 Rectangular in shape
a) Multiply the depth of the layer, length of the vessel and width of the vessel in feet to get the volume in cubic feet.
b) Convert to gallons by multiplying the volume in cubic feet by 7.48.
c) Add layer volumes for total volume in vessel.

8. PIT AND TROUGH SAMPLING

8.1 Determine suitable access points for sampling.
8.2 Take a Sample.
8.3 Sampling with a Sludge Judge®
8.4.1 Add extensions and insert the Sludge Judge® into the pit or trough.
8.4.2 Gently move the apparatus up and down.
8.4.3 Shake vigorously to sample sludges and to properly seat the ball at the bottom.
8.4.4 Slowly begin to withdraw the Sludge Judge®.
8.4.5 Remove the extensions that were not in contact with sample matrix.
8.4.6 Continue to withdraw the Sludge Judge® while wiping off the outside using absorbent pads or towels.
8.4.7 Record layer depths in inches and total depth collected in inches.

8.4.8 Transfer the bottom layer into a pre-cleaned sample container(s) and then discard the remainder of the layer. Each layer should be a separate sample.
8.4.9 Cap the sample container tightly, label and record in the Drum / Vessel Inventory Log.
8.4.10 Transport sample to the decontamination zone.

8.5 Sampling with a Glass Thief Sampler
8.5.1 Insert the Glass Thief sampler into the pit or trough and slowly lower at the rate where the liquid inside and outside the sampler tube are at the same height. Lower almost to the bottom or until a solid layer is encountered.
8.5.2 Cap the top of the sampling tube with a tapered stopper or thumb, ensuring the liquid remains within the sampling tube.
8.5.3 Carefully remove the capped tube from the trough or pit and insert the uncapped end in the sample container.
8.5.4 Record layer depths in inches and total depth collected in inches.
8.5.5 Release stopper and allow the sample layer to drain into the sample container. Each layer should be a separate sample.
8.5.6 Cap the sample container tightly, label and record in the Drum / Vessel Inventory Log.
8.5.7 Transport sample to decontamination zone.

8.6 Sampling with a COLIWASA
8.6.1 Put the Coliwasa sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
8.6.2 Insert sampler into the pit or trough and slowly lower at the rate where the liquid inside and outside the sampler tube are at the same height.
8.6.3 When the sampler stopper hits the bottom of the waste pit or trough, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.
8.6.4 Slowly withdraw the coliwasa from the pit or trough with one hand, while wiping the outside with a disposable cloth or rag with the other hand.
8.6.5 Record layer depths and total depth collected in inches.
8.6.6 Carefully discharge each sample layer by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in the sample container. Each layer should be a separate sample.
8.6.7 Cap the sample container, label, and record on the Drum/Vessel Inventory Log.
8.6.8 Unscrew the T-handle of the sampler and disengage the locking block. Clean sampler.
8.6.9 Transport sample to decontamination zone.

8.7 Sampling with a Scoop
8.7.1 Sample any solid or gel layers with a sample scoop as needed.
8.7.2 Record layer depths and total depth collected in inches.

8.7.3 Place each layer of solid/gel in a separate sample container, label, and record in the Drum / Inventory Log.

8.7.4 Transport sample to the decontamination zone.

8.8 Calculating Pit or Trough Volume

8.8.1 Square or rectangular in shape

8.8.1.1 Measure the length and width (in feet) and estimate the depth of each layer (in feet).

8.8.1.2 Multiply the length of the pit or trough, width of the pit or trough and depth of the sample layer to obtain a volume in cubic feet of each layer.

8.8.1.3 Convert to gallons by multiply the volume in cubic feet by 7.48.

8.8.1.4 Add layer volumes for total volume in vessel.

9. FIELD RECORDS

9.1 Drum / Vessel Inventory Log

Complete the Drum / Vessel Inventory Log for each vessel that is encountered on a project site, even the ones that were sealed and therefore not sampled. The data collected and recorded includes the following (the numbers in parentheses correspond to the fields numbered on Attachment A):

Item	Samplers' complete	Chemist completes
1. Drum / Vessel Number (1)	X	
2. Site Name (2)	X	
3. Location (3) – location of site	X	
4. Date (4) – date the Drum / Vessel Inventory Log was completed	X	
5. TO# / Project # - A project / TO association with the data collected	X	
6. Sampler (6) – Chemist completing the Drum / Vessel Inventory Log	X	
7. Time (7) – time the Drum / Vessel Inventory Log was completed	X	
8. Weather / Temperature (8) - Weather conditions during sampling (i.e., temperature and/or precipitation)	X	
9. Drum / vessel Type (9) – Circle either of the following: Poly-lined, Fiber, Steel, Poly, Stainless Steel, Nickel	X	
10. Lid Type (10) – Circle either of the following: Ring-top, Closed-top	X	
11. Bungs (11) – Circle either of the following: Present, Missing	X	
12. Drum / vessel Condition (12) – record "Y" for yes or "N" for no beside "Meet DOT Spec."; and circle either good, fair or poor for the integrity of the drum / vessel	X	
13. Drum / vessel Size (13) – circle either of the following indicating volume of drum / vessel when full: 110, 85, 55, 42, 30, 16, 10, 5, other	X	
14. Drum / vessel Contents (14) – circle either of the following indicating the volume that is currently in the drum / vessel: Full, ¾, 2/3, ½, 1/3, ¼, <1/4, other	X	

Item	Samplers' complete	Chemist completes
15. Overpacked (15) – circle No or Yes	X	
16. Overpack Type (16) – circle either of the following indicating the material of the drum overpack: steel, poly, fiber	X	
17. Overpack Size (17) – record the size of the drum overpack	X	
18. Layers (18) – once table is complete will indicate the number of layers present in the drum/vessel based on the number of rows completed	X	
19. Physical State (19) – check either of the following for each layer: liquid, solid, gel, sludge	X	
20. Color (20) – record the color of each layer of material using any of the following: BLUE WHITE BLACK RED CREAM ORANGE PINK YELLOW GRAY COLORLESS AMBER PURPLE GREEN BROWN GREEN-BLUE TAN	X	
21. Clarity (21) – check either of the following concerning each layer of the material: clear, cloudy, opaque. Dark samples may need a small aliquot removed from the source to accurately determine sample clarity.	X	
22. Layer Thickness (22) – record the estimated depth (inches) of each layer	X	
23. Field Analysis – pH (23) – record the pH of each layer	X	
24. Field Analysis – PID (24) – record the vapor analysis for each layer as determined using the photoionization detector (PID). The PID scale reads in 0 to 2,000 parts per million (PPM)	X	
25. Field Analysis – CGI (25)	X	
26. Field Analysis - OVA / FID (26)	X	
27. Field Analysis – Other (27)	X	
28. Drum/vessel Labels/Markings – DOT (28) – record the hazard category, if present, from placards or stencils on drum/vessel. Example: Corrosive Liquid	X	
29. Drum/vessel Labels/Markings – UN / NA (29) – record the UN or NA numbers if present on the drum/vessel.	X	
30. Mfg. Name and Address (30) – List the Manufacturers name and address	X	
31. Chemical Name (31) – record any chemical compound, key ingredient, or the chemical name of the contents on the label or stenciled on the drum/vessel. Include all if more than one name is on the drum/vessel and indicate if it's a label, stenciled, or handwritten.	X	
32. Additional information (32) - This space is for additional information or comments for which no specific space is designated. It can include unusual comments or problems such as the contents are too hard to sample, drum/vessel color, or that colored crystals have	X	

Item		Samplers' complete	Chemist completes
	formed on the drum/vessel. Include in this section if there is the presence of Biological hazards		

9.2 Sample Labels
Sample labels are completed with collector's signature or first initial and last name; date and time of sample collection; sample ID; preservative; and analysis required.

9.3 Chain – of - Custody
Completed chain-of-custody forms are maintained for all samples. A sample chain-of-custody form is included as Attachment B. The original form will be sent to the laboratory with the samples and signed by the lab upon receipt. Original completed chain-of-custody forms will be returned to the client with the analytical report.

10. DECONTAMINATION

All equipment taken to the field is assumed to be clean. The following procedures, or that specified in the site-specific documents, are completed during a sampling event for multiple uses of equipment, at the conclusion of equipment use at the site and if visual evidence indicates a need at the onset of equipment use. This does not apply for dedicated equipment.

1. Hand wash, or flush/pump through automatic samplers / equipment, with a non-phosphate laboratory detergent dissolved in tap water;
2. Rinse with tap water;
3. Rinse thoroughly with deionized water; and
4. Allow to air dry.
5. Wrap in aluminum foil and a plastic bag, if neded, and store in a clean, dry area.

Isopropanol, acetone or hexane may be necessary depending on the nature of the matrix sampled.

11. SAMPLE SHIPMENT

Equipment decontamination chemicals may need to be shipped to the site and samples may need to be shipped to the laboratory. All shipping is completed in accordance with the current federal and international regulations (DOT, EPA, IATA). Shipping stipulations are to be included in the project documents, but should you have any questions regarding shipping of any materials to and from the site, contact the authorized shipping representative in your home office.

ATTACHMENT A – DRUM / VESSEL INVENTORY LOG

ATTACHMENT A: DRUM / VESSEL INVENTORY LOG

KEMRON Environmental Services	DRUM / VESSEL INVENTORY LOG	Drum Number: 1
Site Name: 2	Location: 3	Date: 4
TO # / Project #: 5	Sampler: 6	Time: 7

Weather/Temperature: 8

Drum Type: 9 Poly-lined Fiber Steel Poly Stainless Steel Nickel

Lid Type: 10 Ring-top Closed-top Bungs: 11 Present Missing

Drum Condition: 12 Meet DOT Spec. Good Fair Poor

Drum Size: 13 110 85 55 42 30 16 10 5 Other

Drum Contents: 14 Full 3/4 2/3 1/2 1/3 1/4 <1/4 Other

Overpacked: 15 No Yes Overpack Type: 16 Steel Poly Fiber Overpack Size: 17

Layers 18	Physical State 19				Color 20	Clarity 21			Layer Thickness 22	Field Analysis
	Liquid	Solid	Gel	Sludge	Use standard colors	Clear	Cloudy	Opaque	(Inches)	pH 23 PID 24 CGI 25 OVA / FID 26 Other 27
A										Drum Labels / Markings
B										DOT 28
C										UN / NA 29

Mfg. Name and Address: 30

Chemical Name: 31

Additional Information: 32

HAZSCAN DATA

Biohazard Potential * 33 yes no

Hazard Category: 35

Radiation: 34 Positive *

Analyst: 36

Negative MREM / HR

Date Performed: 37

Layers 38	Physical State 39				Color 40	Clarity 41			React * 42	Water Sol 43	pH 44	Hex Sol 45	Oxid * 46	Per ** 47	Hal 48	Flammability 49	Acid Test 50	Reac Sul 51	CN 52
	Liquid	Solid	Gel	Sludge	Use standard colors	Clear	Cloudy	Opaque	Air or Water	S PS I Rel. Dens. H L	CA (≤2) A (2-4) N (5-8) B (9-11) CB (≥11)	S I	+ -	+ -	+ -	F C N	Sul (eggs) CN (bubbles) As (green)	+ -	+ -
A																			
B																			
C																			

PCB Concentration 53 Other Test 54

Comments 55

Bulk Group: 56	Waste Stream: 58
Bulk Group Number: 57	Waste Stream Number: 59

* If material is positive perform no further tests **If positive for Hex Sol or Char Ignit test and Peroxide is positive, perform no further testing

COMPLETED BY (signature): DATE:

REVIEWED BY (signature): DATE:

FOR COMPLETION INSTRUCTIONS SEE SECTION 11 OF THE DRUM SAMPLING SOP (08-DRM-00) OR SECTION 12 OF THE HAZSCAN SOP (08-HAZ-00)

ATTACHMENT B – CHAIN OF CUSTODY

COC No. A 39472

109 Starlite Park
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name:	
Project Contact:	Contact Phone #:
Turn Around Requirements:	Location:
Project #:	Project Name:
Sampler (print):	Signature:

Program
- ☐ NPDES
- ☐ AFCEE
- ☐ RCRA
- ☐ USAGE
- ☐ Other ____________

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold																ADDITIONAL REQUIREMENTS

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:

*Homogenize all composite samples prior to analysis

Page ______ of ______

FIGURE 1 – COLIWASA SAMPLER

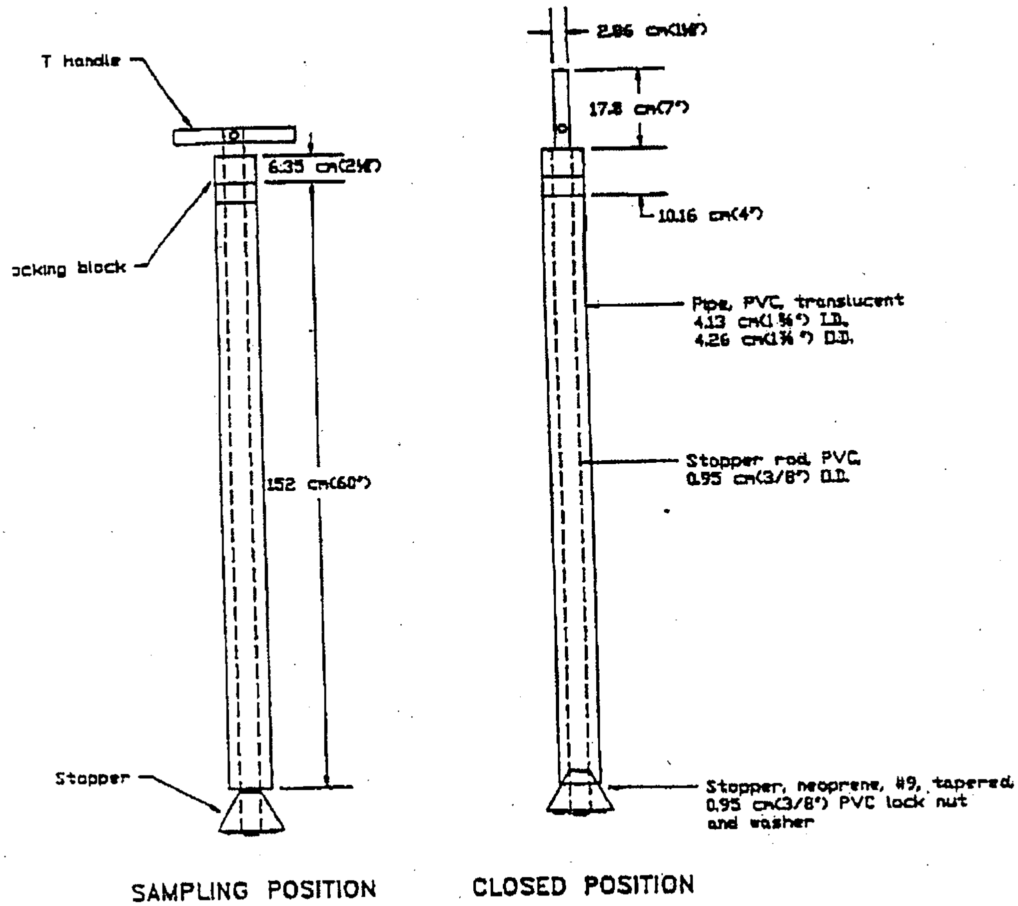


Figure 1
08-VES-00
COLIWASA Sampler

FIGURE 2 – GLASS THIEF

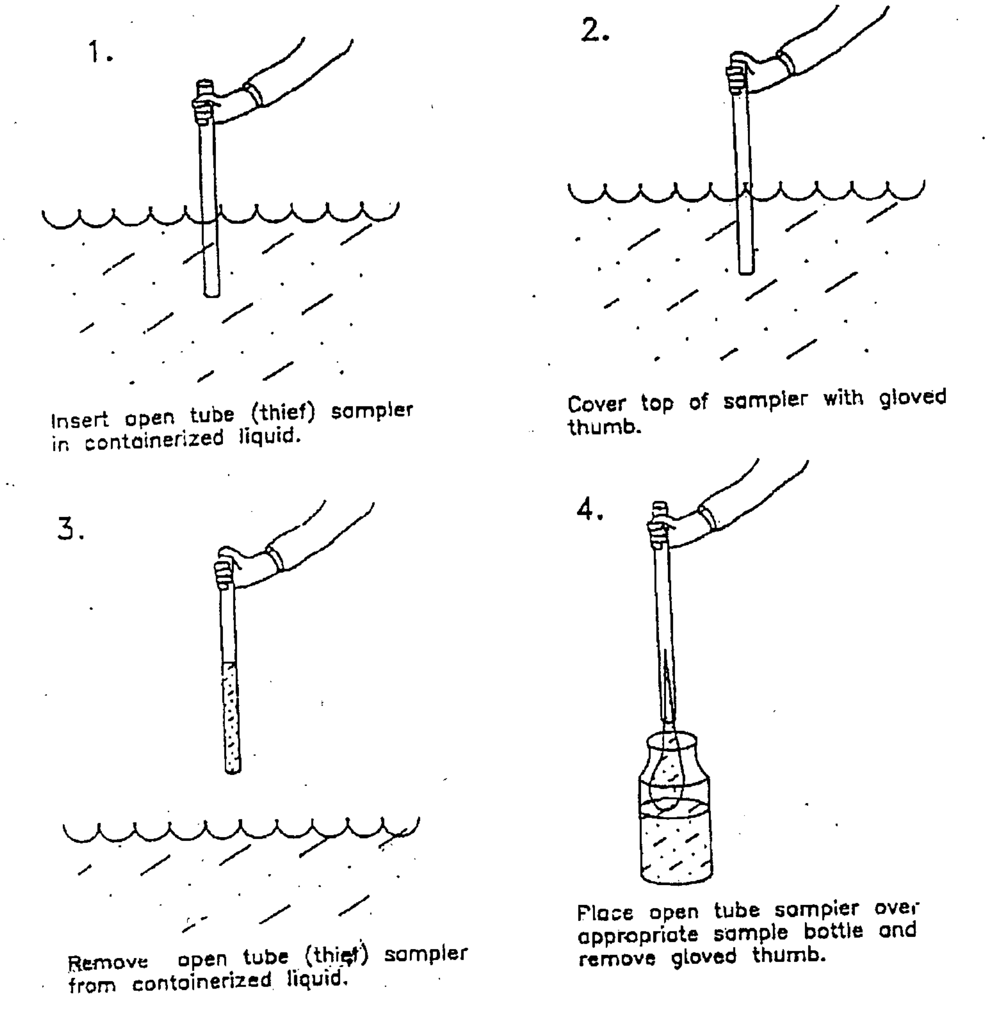
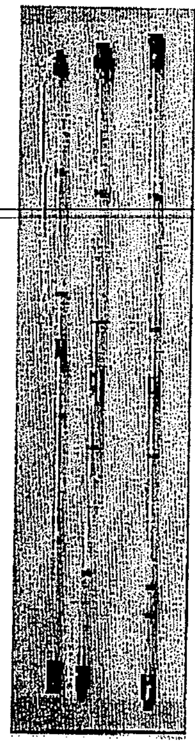


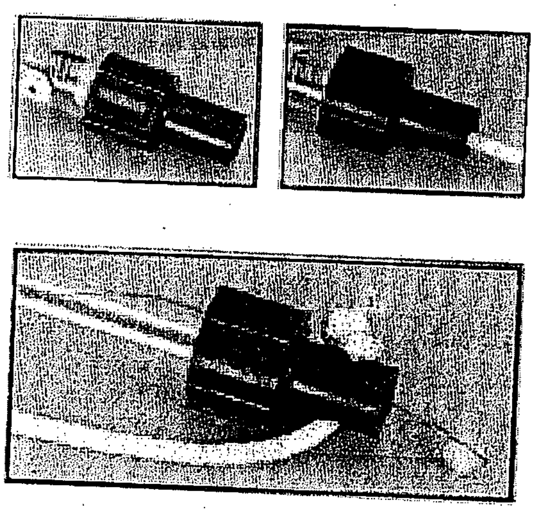
Figure 2

08-VES-00
Glass Thief

FIGURE 3 – SLUDGE JUDGE®

Figure 3
Sludge Judge





Document Control #: 08-DRM-01

STANDARD OPERATING PROCEDURE FOR DRUM SAMPLING

Issue Date: November 8, 2004

Revision 01
Last Review/Implementation Date: October 2010

Approved by:

Lou Ehrhard, Corporate Quality Assurance Manager — 10/11/2010 Date

John Dwyer, Executive Vice President — 10/11/2010 Date

TABLE OF CONTENTS

1. PURPOSE

The objectives of drum sampling are to ensure that valid, appropriate and representative samples are collected that meet the requirements of the project, and to prevent deterioration and contamination of the samples before laboratory analysis. By complying with procedures specified in this Standard Operating Procedure (SOP), KEMRON will ensure that the following are successfully completed:

- Determine the various physical states of material present in the drum.
- Obtain a sample of each layer.
- Correctly log all relevant information about the drum contents and origins.
- Prevention of contamination or cross-contamination of samples during collection, containerization, transit and storage.
- Obtain and record accurate and complete sampling data.
- Preparation of complete and correct sample labels.
- Preparation and maintenance of sample chain-of-custody.

2. SCOPE

Drum staging, opening and sampling are addressed in this SOP. This SOP applies to KEMRON personnel and subcontractors collecting drum samples for KEMRON projects. This SOP applies to KEMRON personnel and subcontractors collecting samples from drums for KEMRON projects. Client, federal, or state requirements, or project-specific requirements may dictate specific types of equipment or procedures to be used when applying this SOP to a particular project. Deviations from this SOP to accommodate site-specific requirements shall be documented in project planning documents and approved by the KEMRON Project Manager and Project Quality Assurance (QA) Manager, if applicable, prior to the performance of work.

3. RESPONSIBILITIES

Project Manager Responsibilities
The KEMRON Project Manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOP and the project-specific work plan. The KEMRON Project Manager ensures all field staff have reviewed and signed off on this SOP prior to beginning field work. A sign-off sheet covering all SOPs related to the project will be prepared and filed with project documents.

Field Staff Responsibilities
The KEMRON field staff prepares, organizes, and inspects all equipment required for the sampling event prior to the initiation of sampling activities. The field sampler and shipper are responsible for initiating, maintaining, and transferring chain-of-custody. Upon completion of the sampling event, the field staff returns all equipment to the designated storage area ensuring that

the equipment is decontaminated and in a condition ready for reuse. KEMRON field staff are required to follow procedures specified in this SOP, or approved project-specific SOP, prior to initiating the sampling event. Field staff are required to sign off that they have read and understand this SOP prior to beginning field work.

4. DEFINITIONS

Drum Opening Equipment:

Backhoe Spike (see Figure 1): A backhoe spike is a tool consisting of a metal spike attached or welded to a backhoe bucket used to remotely open drums.

Drum Deheader (see Figure 2): Constructed of forged steel with an alloy steel blade, a drum deheader is designed to completely or partially cut the lid of a closed-head drum with scissor-like cutting action.

Hand Pick, Pickaxe, and Hand Spike (see Figure 3): These tools are usually constructed of brass or a non-sparking alloy with a sharpened point that can penetrate a drum lid or head when the tool is swung.

Hydraulic Drum Opener (see Figure 4): A hydraulic drum opener consists of a manually operated pump which pressurizes oil through a length of hydraulic line, where hydraulic pressure is used to pierce through the wall of a drum.

Non-sparking Tools: Metal tools used for gaining access to various containers that are made of certain metals that do not spark when in contact with stainless steel or aluminum containers. Beryllium is an example.

Pneumatic Bung Remover (see Figure 5): A pneumatic bung remover system consists of a bracketing system, pressurized air, and a pneumatic drill with bit. The bracketing system aligns the pneumatic drill over the bung where the compressed air supply is regulated to operate the pneumatic drill for bung opening.

Tube and Spears: Tube and spears work together to vent swollen drums. A light aluminum tube is used to position the blow of the spear for venting.

Universal Bung Wrench (see Figure 6): A universal bung wrench is commonly used to manually open drums. These wrenches have fittings to remove nearly all bung types. Wrenches are usually constructed of cast iron, brass, or a bronze-beryllium, non-sparking alloy formulated to reduce the likelihood of sparks.

Drum Sampling Equipment:

Composite Liquid Waste Sampler (Coliwasa) (see Figure 7): A glass tube with a central rod designed to capture liquids present in a drum.

Glass Thief (see Figure 8): A glass or polypropylene tube designed to sample liquid portions of various drums.

Sample Scoop: A metal, polyethylene or polypropylene scoop designed to sample solid sludge and gel-like portions of drums.

Drum Types:

Open-top Drum: A drum that is accessible by a removable lid that is secured by a ring. The lid may have 2 bungs or 1 valve and 1 bung.

Closed-top Drum: A drum that is accessible only through a bung or valve on-top of the drum. Some Close-Top Drums have 2 bungs and others have 1 bung and a relief valve.

Inventory: Establishing an inventory entails drum tagging and recording visual qualities of each drum and any characteristics pertinent to the contents' classification.

Lower Explosive Limit (LEL): Lowest concentration (percentage) of a gas or vapor in air capable of producing a flash of fire in presence of an ignition source (arc, flame, heat). Concentrations lower than LEL are 'too lean' to burn.

Monitoring Equipment:

Photo Ionization Detector (PID): An instrument that contains a detector which measures the ionic potential of chemical vapors in the air. It is best used for monitoring organic vapors at the sampling point of a drum. This instrument is best used for detecting unsaturated hydrocarbons especially aromatics (i.e. benzene, toluene).

Flame Ionization Detector (FID): An instrument that contains a detector which measures the breaking of a carbon-hydrogen bond by a flame. Since organic compounds are commonly referred to as hydrocarbons, this detector is best used for detecting all organic vapors encountered during sampling activities.

LEL Meter: An instrument designed to measure the percentage (%) of the LEL of chemical vapors in air. Meters to measure LEL are most commonly known as O^2/LEL meters (can also measure oxygen levels in the atmosphere), and four gas meters (can measure multiple gases such as oxygen, hydrogen sulfide (HS), carbon monoxide (CO), etc. levels in the atmosphere).

Dosimeter: An instrument that measures and indicates the amount of x-rays or radiation absorbed in a given period.

Staging: involves the organization, and sometimes consolidation of drums that have similar wastes or characteristics.

5. PLANNING

The Project Manager provides any project-specific information in written instructions for the sampling crew. Written instructions can be as simple as a sampling requirements report or as detailed as a Sampling and Analysis Plan (SAP). Written sampling instructions may include the following:

a. Sample point identification - sampling locations, ID names, or numbers to be sampled.
b. Site map with sampling/drum locations clearly marked.
c. Sampling equipment requirements.
d. Sampling point accessibility and vehicle requirements.
e. Required constituents for each sampling point.
f. Sample holding times, preservation methods, and analytical method requirements.
g. Sample analyte collection order.
h. Required QA/Quality Control (QC) samples: Equipment Blanks, Trip Blanks, Field Duplicates, Field Blanks, and Laboratory QC samples.
i. Documentation requirements including chain-of-custody, labeling, field data sheets, etc.

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific SAP/ Quality Assurance Project Plan (QAPP). Proper quality assurance requirements should be provided which will allow for collection of appropriate drum samples. Quality assurance requirements typically suggest the collection of a sufficient quantity of QC samples such as field duplicate, equipment and/or field blanks and matrix spike/matrix spike duplicate (MS/MSD) samples. These requirements should be outlined in the SAP/QAPP.

Information regarding the sample containers, preservation techniques and holding times for drum samples will be described in the project specific SAP/QAPP.

Drum sampling may involve chemical hazards associated with the materials being sampled. Adequate health and safety measures must be taken to protect project sampling personnel from potential chemical exposures or other hazards. These measures must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project health and safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed.

6. DRUM SAMPLING PROCEDURES

1. Excavate drum.
2. Tag drum.
3. Transfer drum to appropriate staging area (liquids, solids, lab packs, gas cylinders, empty).
4. Record drum description, condition, drum markings, location of drum retrieval on the Drum / Vessel Inventory Log.

5. Open the Drum (Universal Bung Wrench, Drum Deheader, Hand Pick, Hand Spike, Pickaxe, Backhoe Spike, Hydraulic Devices, Pneumatic Devices, Tube and Spears).
   a) Universal Bung Wrench:
      i. Drums should be positioned upright with the bung facing up, or, for drums with bungs on the side, laid on their sides with the bung plugs facing up.
      ii. The wrenching motion should be a slow, steady pull across the drum. If the length of the bung wrench handle provides inadequate leverage for unscrewing the plug, a "cheater bar" can be attached to the handle to improve leverage.
   b) Drum Deheader (see Figure 7):
      i. Close-top drums are opened with a drum deheader by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw to hold the deheader against the side of the drum.
      ii. Moving the handle of the deheader up and down while sliding the deheader along the chime will enable the entire top to be rapidly cut off, if so desired. The initial cut should be made very slowly to allow for the gradual release of any built-up pressure.
   c) Hand Pick, Hand Spike, or Pickaxe (see Figure 6): Using force, penetrate the drum lid or head with a hand pick, hand spike or pickaxe.
   d) Backhoe Spike: Punch a hole in the drum head with the spike attached to the backhoe.
   e) Hydraulic Devices: Attach piercing device with a metal point to the end of a hydraulic line and push into the drum by hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head of the drum. Some metal piercers are hollow or tube-like so that they can be left in place if desired and serve as a permanent tap or sampling port.
   f) Pneumatic Bung Remover: Move drum to an upright and level position. Attach the bracketing system on the drum for positioning the drill. Fit the drill with the appropriate sized bit for bung loosening. Regulate the compressed air for drill operation. Remove the bracketing system prior to sampling.
   g) Tube and Spears: Position a light aluminum tube at the vapor phase of the drum and attach over the chime for a secure fit. Insert the spear in the tube and position against the drum wall. Drive the spear through the drum wall with a firm blow. Following venting, remove bung and begin sampling.
6. Complete a Radioactive Survey.
   Hold the dosimeters approximately two (2) inches from the opening and record the equilibrated reading. Any readings that exceed two (2) mrem/hr should be considered highly radioactive and segregated.
7. Take LEL readings.
8. Take Organic Vapor Readings.
   Hold the PID/FID probe at the opening but not inside the drum. Record the highest reading.
9. Take a Sample.
   a) Sampling with a Glass Thief Sampler
      i. Remove cap/cover from sample container.
      ii. Insert sampler into drum and slowly lower at the rate where the liquid inside and outside the sampler tube are at the same height. Lower almost to the bottom of

the drum or until a solid layer is encountered. Minimally, about 1 foot of tubing should extend above the drum.

iii. Cap the top of the sampling tube with a tapered stopper or thumb, ensuring the liquid remains within the sampling tube.
iv. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container.
v. Record layer depths in inches and total depth collected in inches.
vi. Release stopper and allow the sample layer to drain into the sample container. Each layer should be a separate sample.
vii. Disposal of glass tube is completed per direction from the Project Manager and may include breaking and adding to the drum sampled.
viii. Cap the sample container tightly, label and record in the Drum / Vessel Inventory Log.
ix. Replace the bung.
x. Transport sample to decontamination zone.

b) Sampling with a Coliwasa

i. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
ii. Insert sampler into drum and slowly lower at the rate where the liquid inside and outside the sampler tube are at the same height.
iii. When the sampler stopper hits the bottom of the waste drum, push the sampler tube downward against the stopper to close the sampler.
iv. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.
v. Slowly withdraw the coliwasa from the waste drum with one hand, while wiping the outside with a disposable cloth or rag with the other hand.
vi. Record layer depths in inches and total depth collected in inches.
vii. Carefully discharge each sample layer by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in the sample container. Each layer should be a separate sample.
viii. Cap the sample container, label, and record on the Drum / Vessel Inventory Log.
ix. Unscrew the T-handle of the sampler and disengage the locking block.
x. Clean sampler.
xi. Replace the bung.
xii. Transport sample to decontamination zone.

c) Sampling with a Sample Scoop

i. Remove the entire lid of the drum.
ii. Sample any solid or gel layers with a sample scoop as needed.
iii. Record layer depths in inches.
iv. Place each layer of solid/gel in a separate sample container, label, and record in the Drum / Inventory Log.
v. Replace lid of drum if open-top drum or put drum in overpack.
vi. Transport sample to the decontamination zone.

10. Calculate and record layer volume.

a) Layers will be delineated in inches during drum sampling.
b) Since the standard 55-gallon drum is 36 inches tall, the layer volume can be estimated by dividing the layer depth in inches by 36 and then multiplying by 55 to convert into gallons.
c) Other size drums can have their heights measured from the outside and be converted to gallons as before using the new height instead of 36 in the calculation.
d) Total the drum layer volumes to get the total volume in the drum.

7. FIELD RECORDS

7.1 Drum / Vessel Inventory Log

Complete the sampling portion of the Drum / Vessel Inventory Log for each drum that is encountered on a project site, even the ones that were sealed and therefore not sampled (see Attachment A).

7.2 Sample Labels

Sample labels are completed with collector's signature or first initial and last name, date and time of sample collection, sample ID, preservative, and analysis required.

7.3 Chain-of-Custody

Completed chain-of-custody (COC) forms are maintained for all samples. A sample chain-of-custody form is included as Attachment B. The original form will be sent to the laboratory with the samples and signed by the lab upon receipt. Original completed chain-of-custody forms will be returned to the client with the analytical report. A copy of the COC will be retained by the field crew (sampler) and kept with field records.

8. DECONTAMINATION

All equipment taken to the field will be clean. The following procedures, or that specified in the site-specific documents, are completed during a sampling event for multiple uses of equipment, at the conclusion of equipment use at the site, and if visual evidence indicates a need at the onset of equipment use. This does not apply for dedicated equipment.

1. Hand wash (or flush/pump through automatic samplers / equipment) with a non-phosphate laboratory detergent dissolved in tap water.
2. Rinse with tap water.
3. Rinse thoroughly with deionized water.
4. Allow to air dry.
5. Wrap in aluminum foil and a plastic bag, if neded, and store in a clean, dry area.

Decontamination solvent such as isopropanol, acetone or hexane may be used for equipment exposed to high levels of organics (e.g., NAPL). Use of specific decontamination solvents should be addressed in project-specific planning documents and the waste solvents managed and disposed in accordance with applicable regulations.

9. SAMPLE SHIPMENT

Equipment decontamination chemicals may need to be shipped to the site and samples may need to be shipped to the laboratory. All shipping is completed in accordance with the current federal and international regulations (DOT, EPA, IATA). Shipping stipulations are to be included in the project documents, but should you have any questions regarding shipping of any materials to and from the site, contact the authorized shipping representative in your home office.

10. ASSOCIATED SOPs

Field Log Book, SOP 07-DOC-00

11. REFERENCES

USEPA, November 1994. Drum Sampling. SOP# 2009 REV. #0.0

Drum Handling Practices at Hazardous Waste Sites, EPA-600/2-86-013.

ATTACHMENT A – DRUM / VESSEL INVENTORY LOG

KEMRON Environmental Services	DRUM / VESSEL INVENTORY LOG	Drum Number: 1
Site Name: 2	Location: 3	Date: 4
TO # / Project #: 5	Sampler: 6	Time: 7
Weather/Temperature: 8		
Drum Type: 9 Poly-lined Fiber	Steel Poly Stainless Steel Nickel	
Lid Type: 10 Ring-top Closed-top	Bungs: 11 Present Missing	
Drum Condition: 12 Meet DOT Spec.	Good Fair Poor	
Drum Size: 13 110 85	55 42 30 16 10 5 Other	
Drum Contents: 14 Full 3/4	2/3 1/2 1/3 1/4 <1/4 Other	
Overpacked: 15 No Yes	Overpack Type: 16 Steel Poly Fiber	Overpack Size: 17

Layers 18	Physical State 19: Liquid	Solid	Gel	Sludge	Color 20: Use standard colors	Clarity 21: Clear	Cloudy	Opaque	Layer Thickness 22 (Inches)	Field Analysis
										pH 23 PID 24
										CGI 25 OVA / FID 26
										Other 27
A										Drum Labels / Markings
B										DOT 28
C										UN / NA 29

Mfg. Name and Address: 30

Chemical Name: 31

Additional Information: 32

HAZSCAN DATA

Biohazard Potential * 33 yes no	Hazard Category: 35
Radiation: 34 Positive * / Negative MREM / HR	Analyst: 36
	Date Performed: 37

Layers 38	Physical State 39: Liquid	Solid	Gel	Sludge	Color 40: Use standard colors	Clarity 41: Clear	Cloudy	Opaque	React * 42	Water Sol 43	pH 44	Hex Sol 45	Oxid * 46	Per ** 47	Hal 48	Flammability 49	Acid Test 50	Reac Sul 51	CN 52
									Air or Water	S PS I Rel. Dens. H L	CA (≤2) A (2-4) N (5-8) B (9-11) CB (≥11)	S I	+ -	+ -	+ -	F C N	Sul (eggs) CN (bubbles) As (green)	+ -	+ -
A																			
B																			
C																			

PCB Concentration 53 Other Test 54

Comments 55

Bulk Group: 56	Waste Stream: 58
Bulk Group Number: 57	Waste Stream Number: 59

* If material is positive perform no further tests **If positive for Hex Sol or Char Ignit test and Peroxide is positive, perform no further testing

COMPLETED BY (signature): DATE:

REVIEWED BY (signature): DATE:

FOR COMPLETION INSTRUCTIONS SEE SECTION 11 OF THE DRUM SAMPLING SOP (08-DRM-00) OR SECTION 12 OF THE HAZSCAN SOP (08-HAZ-00)

ATTACHMENT B – EXAMPLE CHAIN-OF-CUSTODY

COC No. A 39472

KEMRON ENVIRONMENTAL SERVICES
109 Starlite Park
Marietta, OH 45750
Phone: 740-373-4071
Fax: 740-373-4835

CHAIN-OF-CUSTODY RECORD

Company Name:	
Project Contact:	Contact Phone #:
Turn Around Requirements:	Location:
Project #:	Project Name:
Sampler (print):	Signature:

Program:
- ☐ NPDES
- ☐ AFCEE
- ☐ RCRA
- ☐ USACE
- ☐ Other ______

ADDITIONAL REQUIREMENTS

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp. in °C	Remarks:

*Homogenize all composite samples prior to analysis

Page ______ of ______

FIGURE 1 – BACKHOE SPIKE

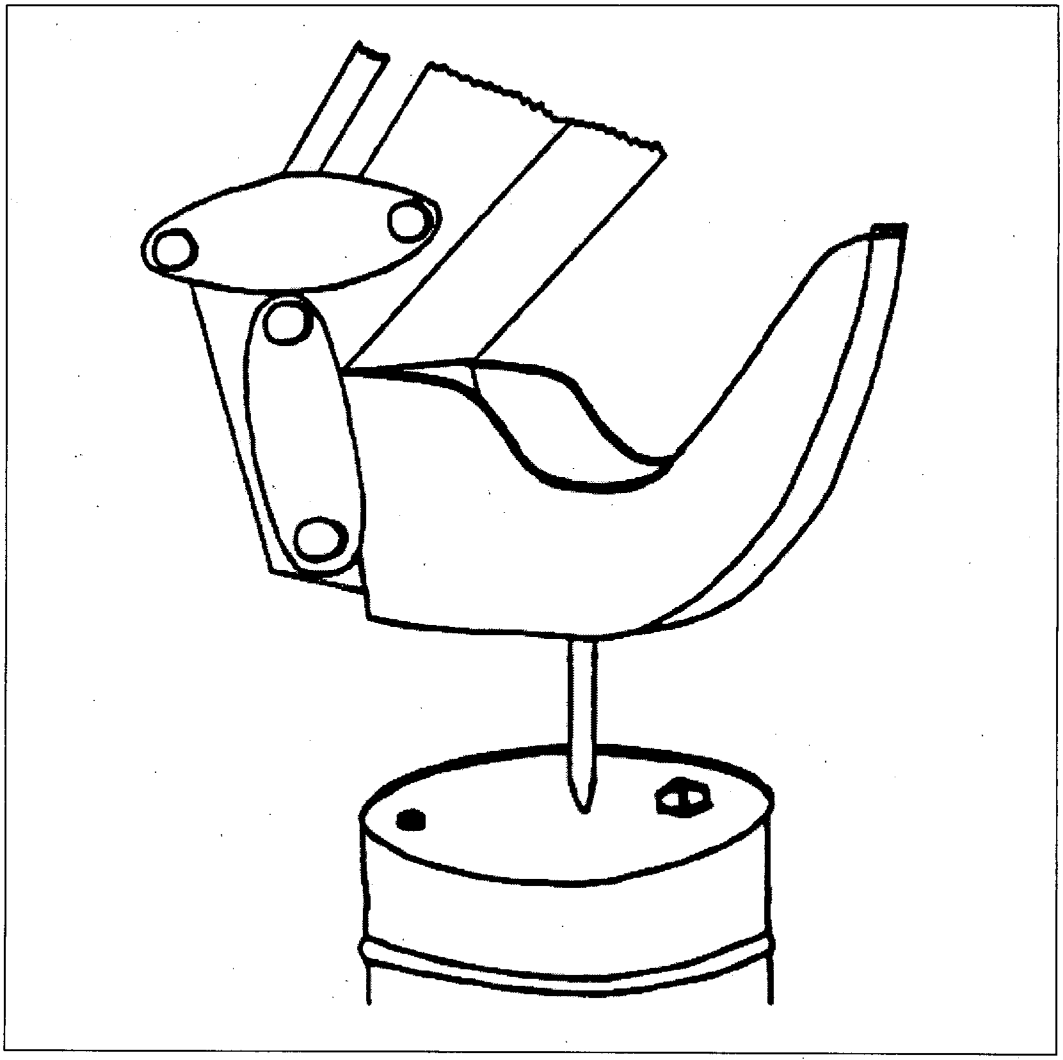


FIGURE 2 – DRUM DEHEADER

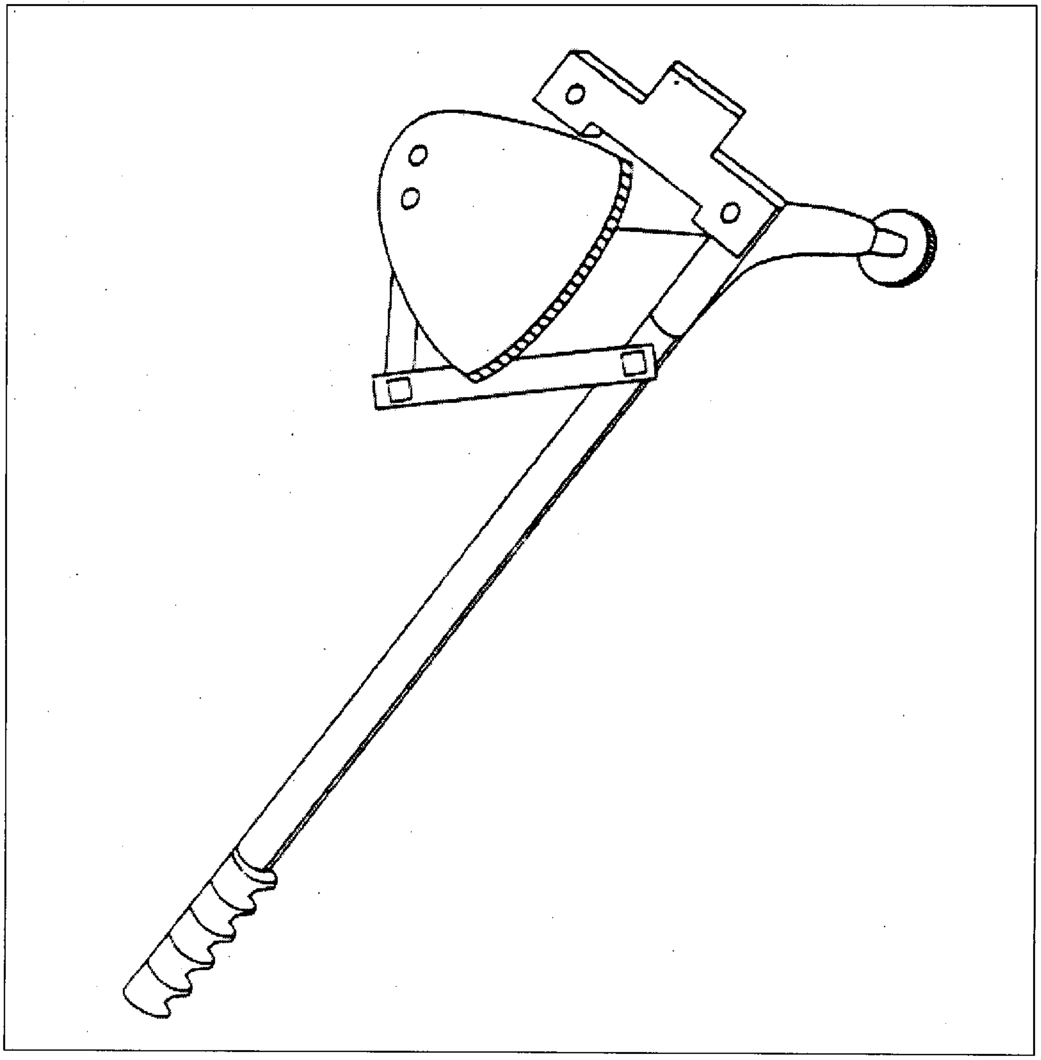


FIGURE 3 – HAND PICK, PICKAXE, AND HAND SPIKE

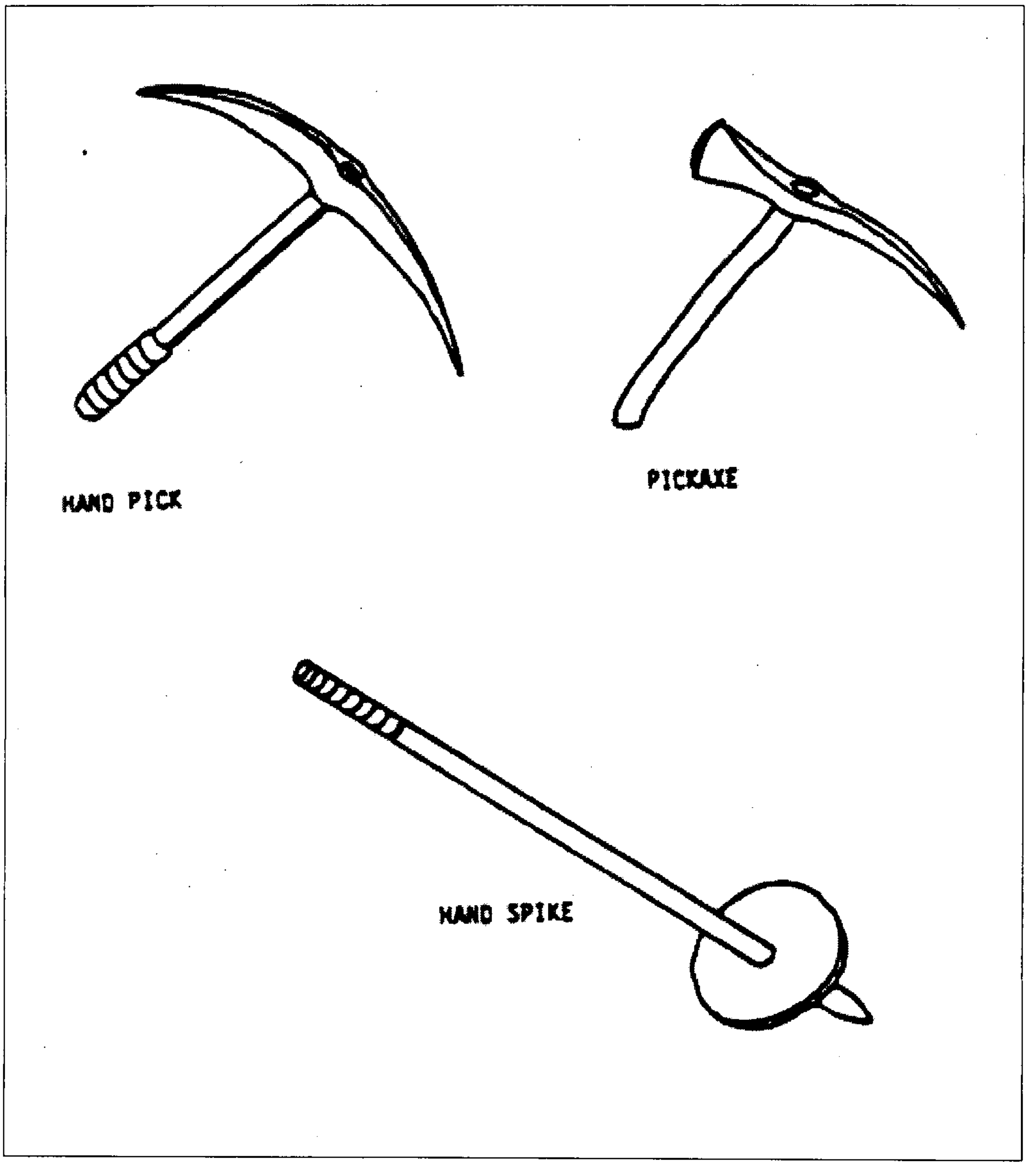


FIGURE 4 – HYDRAULIC DRUM OPENER

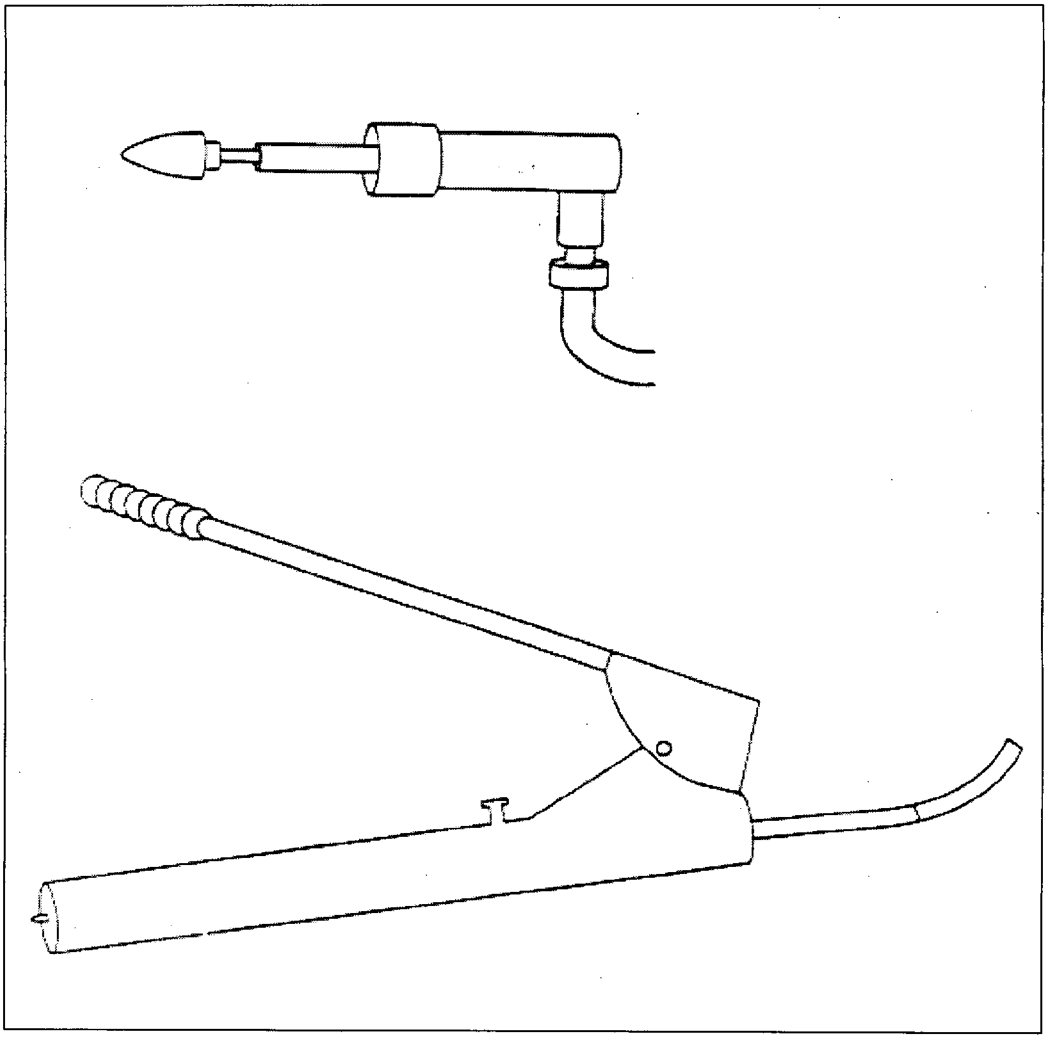


FIGURE 5 – PNEUMATIC BUNG REMOVER

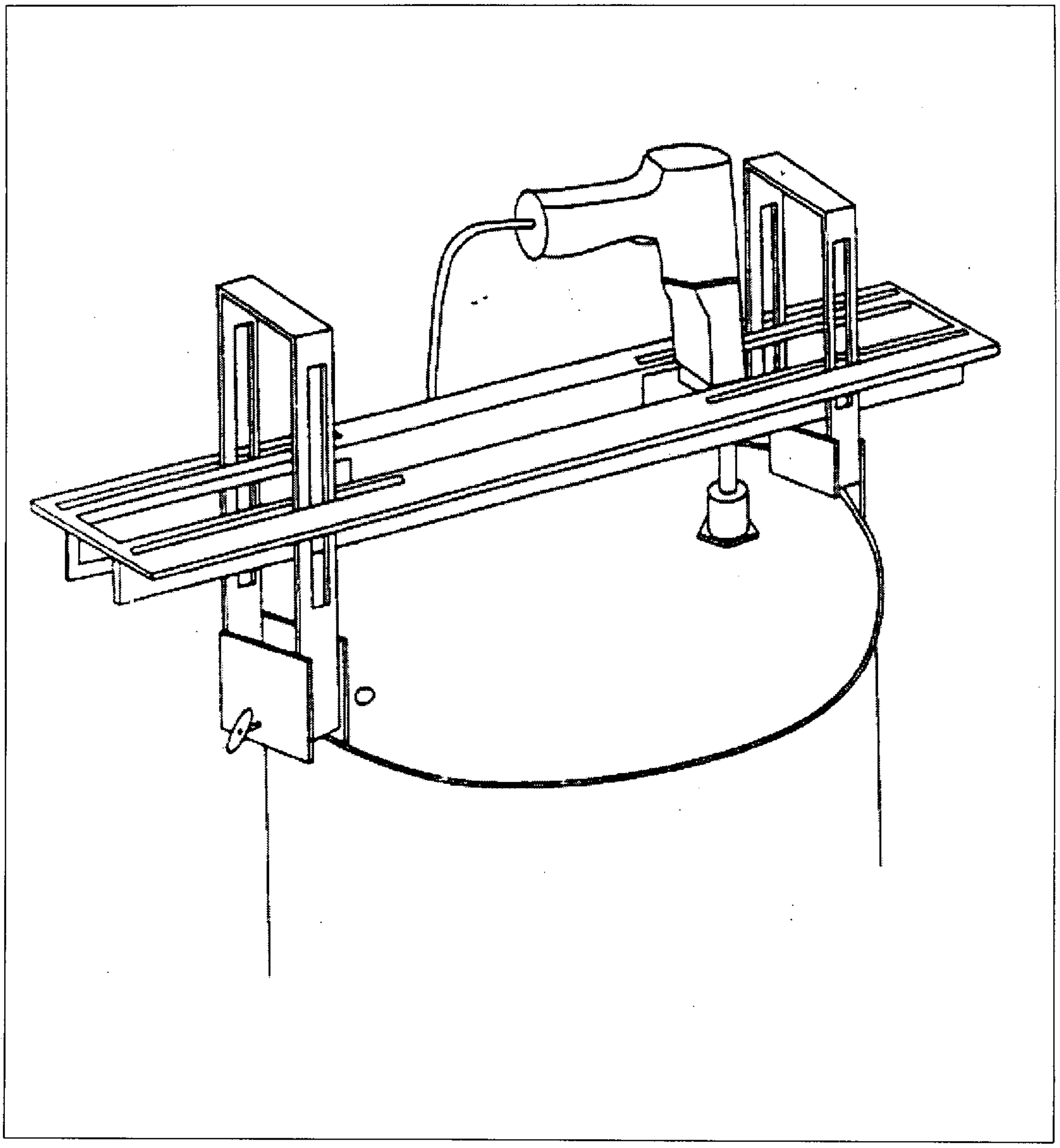


FIGURE 6– UNIVERSAL BUNG WRENCH

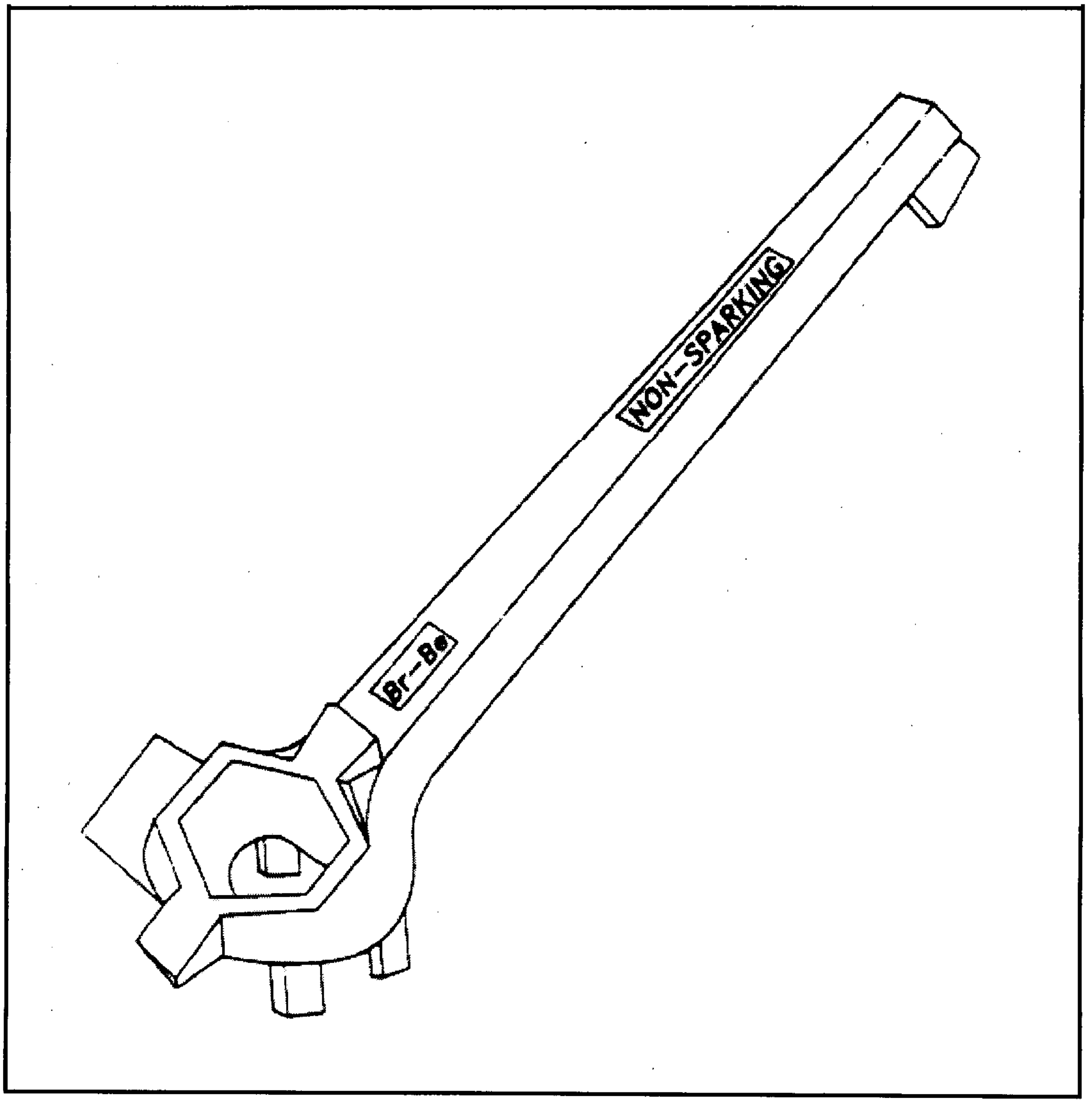


FIGURE 7 – COLIWASA SAMPLER

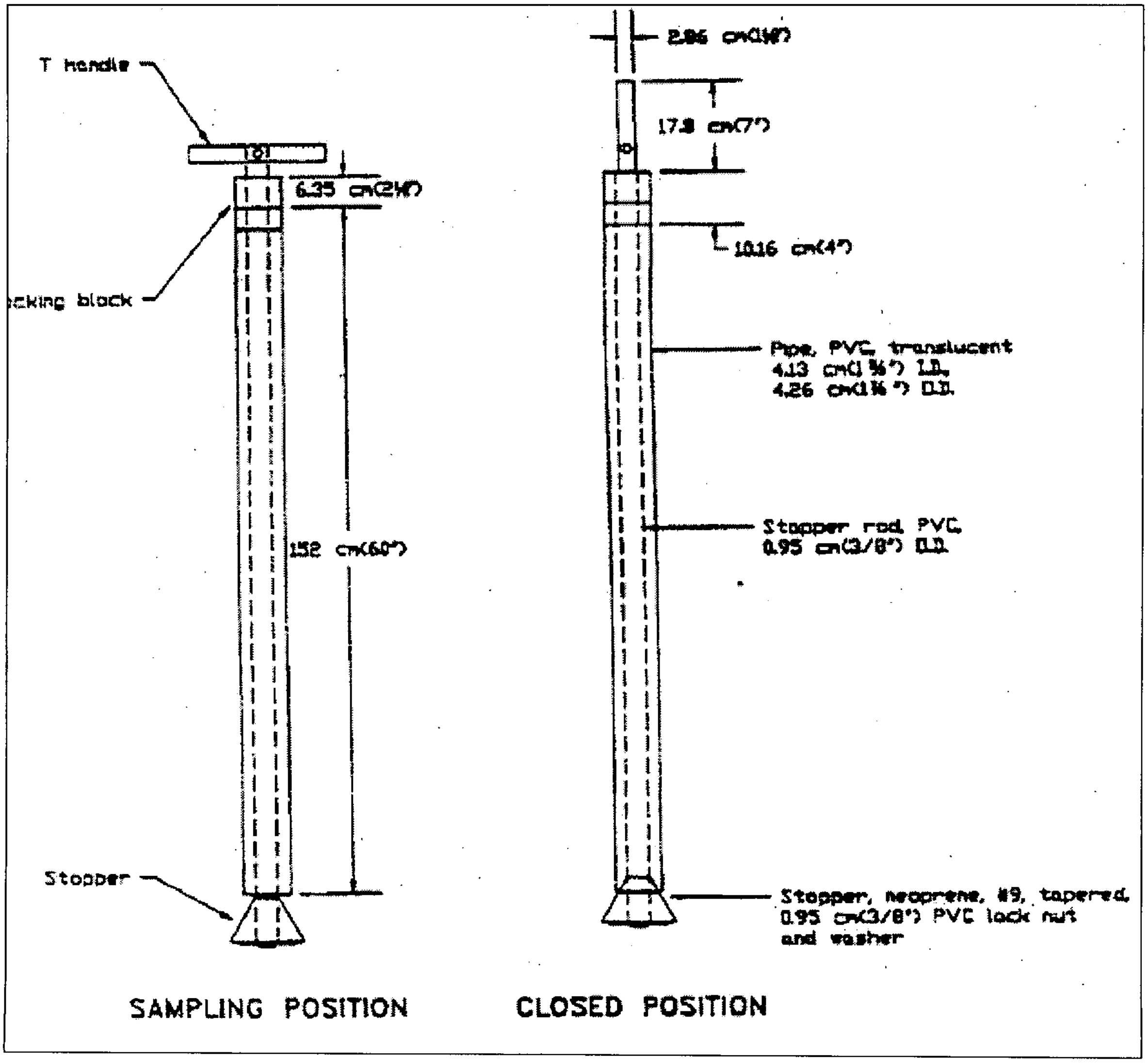
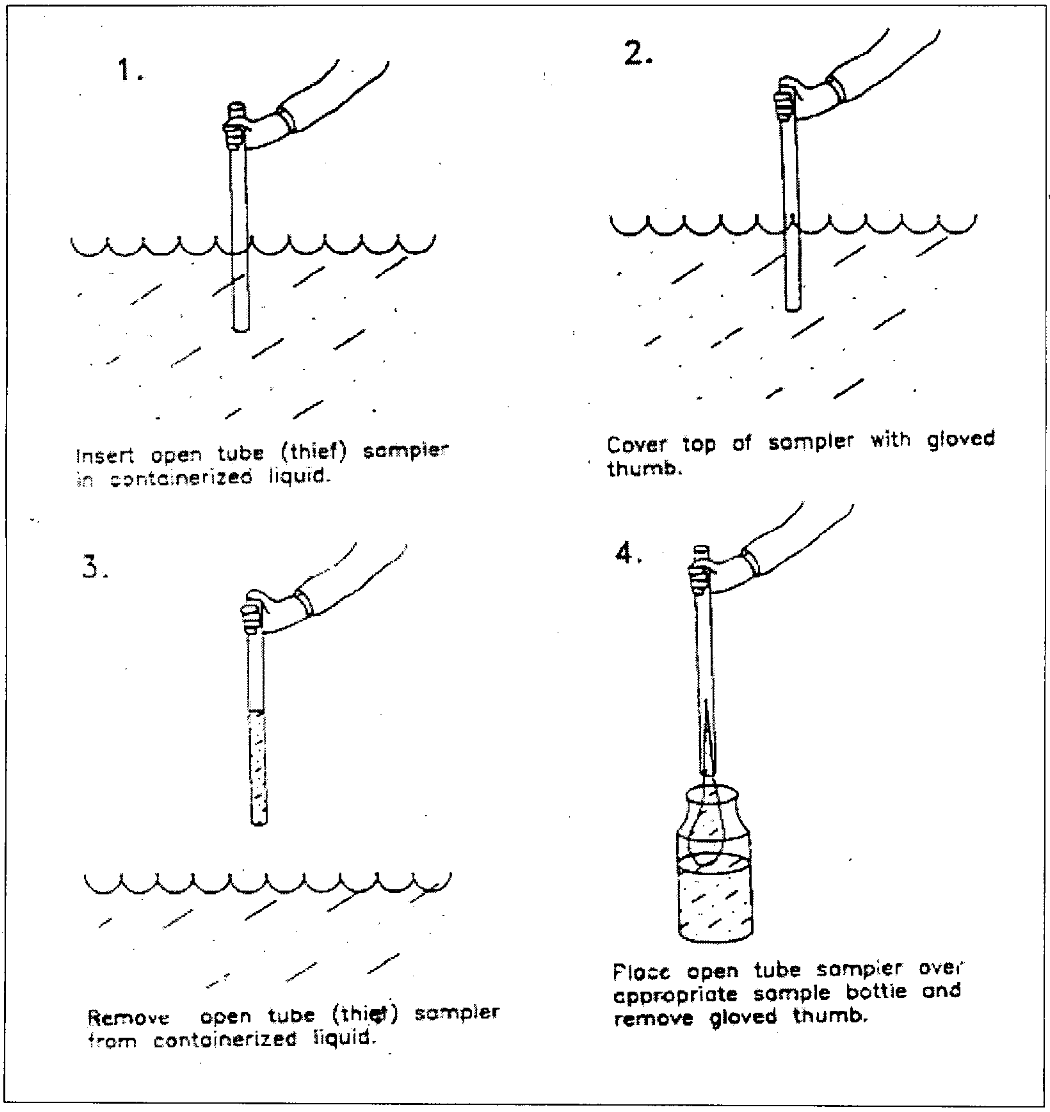


FIGURE 8 – GLASS THIEF



Document Control #: 12-GWS-01

STANDARD OPERATING PROCEDURE FOR GROUNDWATER SAMPLING

Issue Date: November 8, 2004

Revision 01
Last Review/Implementation Date: October 11, 2010

Approved by:

Lou Ehrhard, Corporate Quality Assurance Manager

10/11/2010
Date

John Dwyer, Executive Vice President

10/11/2010
Date

TABLE OF CONTENTS

1. PURPOSE

The objectives of this procedure are to ensure valid and representative samples of groundwater are collected from monitoring wells that meet project requirements and to prevent deterioration and contamination of samples before laboratory analysis. By complying with procedures specified in this Standard Operating Procedure (SOP), KEMRON will ensure that the following are successfully completed:

- Proper well purging
- Proper sampling
- Prevention of contamination or cross-contamination of groundwater samples during collection, containerization, transit and storage
- Obtain and record accurate and complete sampling data
- Preparation of complete and correct sample labels
- Preparation and filing of sample chain of custody
- Communication of adequate instruction to the laboratory

2. SCOPE

This SOP provides technical guidance on groundwater sampling including decontamination procedures, types, and uses of sampling equipment. This SOP applies to KEMRON personnel and subcontractors collecting groundwater samples for KEMRON projects. Client, federal, or state requirements, or project-specific requirements may dictate specific types of equipment or procedures to be used when applying this SOP to a particular project. Deviations from this SOP to accommodate site-specific requirements shall be documented in project planning documents and approved by the KEMRON Project Manager and Project Quality Assurance (QA) Manager, if applicable, prior to the performance of work.

3. RESPONSIBILITIES

Project Manager Responsibilities
The KEMRON Project Manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOP and the project-specific work plan. The KEMRON Project Manager ensures all field staff have reviewed and signed off on this SOP prior to beginning field work. A sign-off sheet covering all SOPs related to the project will be prepared and filed with project documents.

Field Staff Responsibilities
The KEMRON field staff prepares, organizes, and inspects all equipment required for the sampling event prior to the initiation of sampling activities. The field sampler and shipper are responsible for initiating, maintaining, and transferring chain-of-custody. Upon completion of the sampling event, the field staff returns all equipment to the designated storage area ensuring that the equipment is decontaminated and in a condition ready for reuse. KEMRON field staff

are required to follow procedures specified in this SOP, or approved project-specific SOP, prior to initiating the sampling event. Field staff are required to sign off that they have read and understand this SOP prior to beginning field work.

4. DEFINITIONS

Bailer: A bailer is used to sample wells. A bailer may be of stainless steel, Teflon, polyethylene or other appropriate construction and may be composed of a reel system equipped with a Teflon-coated stainless steel suspension cord, a disposable monofilament line or disposable braided filament line. A bailer can be dedicated or non-dedicated to a specific well and disposable or reusable.

Chain-of-Custody: An unbroken trail of accountability that ensures the physical security of samples, data, and records. The chain-of-custody documentation shows times, dates, and names of the individuals relinquishing and receiving the samples identified on the record.

Custody: Physical control of an object, in this case of an environmental sample.

Dedicated: Equipment (bailer or pump) dedicated to a particular well which remains associated only with the assigned well until the work/project is completed.

Depth to Water: The depth to water is the depth from the top of the well casing to the surface of the groundwater. An established point (typically the surveyed top of the well casing) is utilized as a reference point for measuring the depth to water.

Evacuated Well: Removal of standing volume of water in a well by pumping or bailing.

Field Blank: A field blank sample undergoes the full handling and shipping process of an actual sample. It is designed to detect sample contamination that can occur during field operation or during shipment. Field blanks are prepares using certified clean water preserved in the same manner as the other collected samples, and then submitted to the laboratory for analysis.

Flow Rate: A measurement taken of the water flowing from the well when a pump is used. The flow rate is in units of volume per time.

Low-Flow Purge: Per EPA guidance, low-flow purging is purging at rate of 200-500 mL/min to have minimal drawdown of the water table and minimize disruption of the water column. Low-flow purging is accomplished using low-flow purge equipment.

Non-Dedicated: Equipment (bailer or pump) not dedicated to a particular well. Non-dedicated equipment is decontaminated between use or if for one-time use (bailers) then properly disposed of after use.

Purging: The process of removing stagnant water from a monitoring well (water in the screen, well casing, and saturated annulus) immediately prior to sampling, causing its replacement by groundwater from the adjacent formation, which is representative of actual aquifer conditions.

Recharged Well: A well is considered recharged when the water level recovers to at least 80% of the static water level.

Slow Recovery Wells: Slow recovery wells are wells that require more than 6 hours to recharge after purging.

Stabilized Well: Well stabilization is achieved following well purging when water level and field measurements are observed to be consistent between measurements and within project work plan requirements.

Trip Blank: Unlike field blanks, the trip blanks are used for VOCs analysis only. In addition, trip blanks are prepared prior to going into the field by filling containers (VOC vials) with clean water. The samples are kept closed, handled, transported to the field, and then returned to the laboratory in the same manner as the other samples. Trip blanks are used to evaluate error associated with shipping and handling, and analytical procedures. They are used in conjuncture with field blanks to isolate sources of sample contamination already noted in previous field blanks.

Unrecoverable Wells: Wells that have not sufficiently recovered within 24 hours.

Water Column Height: Well depth minus the depth to water.

Water Level Measurement Reference: The point on the well head where water levels are measured (typically the high point of the casing). This point is marked and surveyed as soon as practical after well installation to ensure consistent measurement.

Water Quality Measurements: Groundwater chemistry measurements used to establish the quality of groundwater. Measurements may include: temperature, pH, conductivity, dissolved oxygen (DO), oxidation reduction potential (ORP), and turbidity.

Well Stability: Stability is achieved as specified in the project work plan. The following are provided as a reference.

- Change in groundwater chemistry measurements is within a specified range (indicating stability) by the end of the third well volume purged; or
- Stabilization is considered complete after five well volumes are purged even if field parameters have not met specified range (range established to indicate stability); or
- Stabilization is complete when well is fully evacuated. Using these criteria, measurements are taken to verify the evacuation. Allow well to recharge prior to sampling.

Well Volume Calculation: The standing water volume for typical well diameters is below:

1" Casing = .041 gal/ft
2" Casing = .163 gal/ft
4" Casing = .653 gal/ft
6" Casing = 1.469 gal/ft

or can be calculated using the following formula:

$$\textit{Volume (gallons)} = (3.14)\, r^2\, h \times (7.48\ \frac{gal}{ft^3})$$

r = inside well casing radius (in feet)
h = height (in feet) of the water column in the well

5. PLANNING

The Project Manager provides written instructions of any project-specific information for the sampling crew. The written instructions can be as simple as a sampling requirements report or as detailed as a Sampling and Analysis Plan (SAP). Items in written sampling instructions may include the following:

a) Purging method;
b) Criteria for a complete purge;
c) Criteria for stabilized well;
d) Wells to sample;
e) Method of sampling;
f) Analytical parameters;
g) Applicable regulations for handling purged water;
h) Volume to purge;
i) Sample containers to be used for each analysis;
j) Preservative for each analysis; and
k) Instructions for samples to be field filtered or lab filtered for dissolved metals, if appropriate.

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific SAP/Quality Assurance Project Plan (QAPP). Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements typically suggest the collection of a sufficient quantity of quality control (QC) samples such as field duplicate, equipment and/or field blank, and matrix spike/matrix spike duplicate (MS/MSD) samples. These requirements should be outlined in the SAP/QAPP.

Information regarding the sample containers, preservation techniques and holding times for groundwater samples will be described in the project specific SAP/QAPP.

Groundwater sampling may involve chemical hazards associated with the materials being sampled. Adequate health and safety measures must be taken to protect project sampling personnel from potential chemical exposures or other hazards. These measures must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project health and safety officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed.

6. SAMPLE COLLECTION EQUIPMENT AND PROCEDURES

The tables in this section provide a description of equipment and sampling procedures for different groundwater sampling methods. The project work plan will specify the method and any site-specific requirements. Once the groundwater is sampled, the sample will be aliquoted in the following sequence or as stated in the project-specific planning documents: Field Parameters, Volatile Organic Compounds (VOCs); Semi-volatile Organic Compounds (SVOCs), Pesticides, Herbicides, PolyChlorinated Biphenyls (PCBs), Metals, and Wet chemistry parameters.

Groundwater sampling objectives may vary significantly between projects. Project objectives should be defined within the project-specific planning documents. The list of required materials below identifies the types of equipment which may be used for a range of groundwater sampling applications. The various types of sampling equipment which may be used include:

Well Purging Equipment

- Bailers
- Bladder pumps
- Submersible pumps
- Peristaltic pumps
- Centrifugal Pumps
- Waterra™ pumps

Field Instruments

- Individual or multi-parameter meter(s) to measure temperature, pH, specific conductance, DO, ORP, and/or turbidity
- Flow through cell
- Water level measuring device
- Interface probe or product detection paste

Sampling Equipment

- Reusable or disposable bailers
- Bladder Pump
- Electric Submersible Pump
- Suction Lift Pumps (Peristaltic)

Sample Preparation Equipment
- Filtration equipment
- Intermediate containers
- Sample kit (i.e., bottles, labels, preservatives, custody records, cooler)

General Equipment
- Well keys
- Project-specific sampling plans (SAP, QAPP, HASP) including map of wells to be sampled
- Sample collection records
- Field notebook/pen
- Waterproof marker pens
- Deionized water dispenser bottler
- Sample cup
- Buckets
- Coolers, or sample shuttles
- Instrument calibration solutions
- Power source (e.g. generator and/or battery)
- Equipment decontamination supplies
- Health and safety supplies (PPE, etc)
- First-Aid kit
- Tool box (e.g. bolt cutter, turkey baster, etc.)
- 55-gallon drum for collecting purge water
- Graduated cylinder (determine flow)
- Flow controller for submersible pump

Expendable Materials
- Deionized water supply
- Disposable bailer string (nylon or polypropylene)
- 0.45 micron filters
- Paper towels
- Plastic sheeting
- Ice/blue ice for sample preservation
- Disposable latex powder-free glove liners
- Disposable nitrile gloves
- Plastic trash bags
- Ziploc® bags

This equipment list was developed to aid in field organization and should be used in preparation for each sampling event. Depending on the site-specific sampling plan, additional material and equipment may be necessary and should be determined before the scheduled sampling event. Similarly, not all of the items shown in this list may be necessary for any one sampling event.

TABLE 1: Purging and Sampling by Bailer

Purging & Sampling Equipment:	The Bailer system can be dedicated or non-dedicated. a) Bailer: pre-cleaned closed-top Teflon® or stainless steel bailer or a disposable polyethylene bailer. b) Either of the following: (1) New braided nylon or polypropylene cords, one per well (disposable). (2) Reusable lanyards (monofilament, stainless steel, or Teflon-coated) for bailer systems.
Sampling Procedure:	Prior to sampling, obtain sample containers from laboratory (or laboratories). Ensure presence of preservatives in bottles as appropriate. Before opening the well, a clean working surface shall be set up around the well head using a clean plastic sheet. Prior to opening the well, the required health and safety gear (as specified in the HASP) shall be donned. This, at a minimum, usually means wearing gloves to limit the potential for exposure to contaminants as well as reduce the potential for handling-induced contamination of sampling equipment. ***Preliminary Measurements:*** Measure the depth to water at the pre-marked well casing reference point (notch or other visible mark). To obtain a water level measurement, lower the probe of a water level measuring device into the well until the audible sound of the unit is detected or the light on an electronic sounder illuminates. At this time the precise measurement should be determined (to nearest 0.01 feet) by repeatedly raising and lowering the tape to converge on the exact measurement. Obtain the reading from the top of casing (TOC) measuring point. The water level measurement should be entered on the Groundwater Sample Collection Record or in the field log book. The measurement device shall be decontaminated immediately after use with a non-phosphatic detergent and rinsed with distilled water. Generally, only that portion of the tape which enters the water table should be cleaned. It is important that the measuring tape is never placed directly on the ground surface or allowed to become kinked. Measuring devices, including interface probes, which come into contact with free product, will likely require more thorough decontamination. Calculate the water level (water column height) and volume of water in casing. Note: Following water-level measurement, if free phase product is suspected, measure the product thickness with an interface probe as specified in the work plan. If measurable quantities of product are encountered do not sample and notify the Project Manager immediately. Wells containing free product are generally not used for groundwater sampling, since the concentration of contaminants present in the free product can adversely affect the quality of the water sample, lending to a non-representative water sample. ***Purge Well:*** Note: If non-dedicated equipment is used for purging, at least one equipment blank (or as specified in the work plan) will be collected from the decontaminated / cleaned purge equipment. a) Slowly and gently, lower the bailer into the top of the standing water column. Keeping the bailer at the top of the water column is crucial throughout purging especially at the end of purging. b) Allow bailer to fill and remove from the well. Bailer rope should never touch the ground surface at any time during the purge routine. c) Collect purged water in a graduated bucket, etc. to determine the number of well volumes purged. d) Following each well volume purged, take water level and field parameter measurements. e) Containerize the purged water unless specified otherwise in the project work plan.

Purging a well to dryness may occur under some low-yield conditions. When the well recovers, a cascading effect may occur within the screened zone which can volatilize some organic compounds. This may be considered inappropriate by regulatory agencies when VOCs are the target analyte of interest. Purging a well to dryness, then sampling after it has recovered may be acceptable for other target analytes, however. Under low yield conditions, low-flow sampling pumps such as bladder pumps may be required for VOC sample collection.

Stabilize well: Measure and record water level until 80% static water level is achieved (well fully recharged). Groundwater chemistry stability is achieved as specified in the project work plan.

Sampling

a) Sample wells:
  - Within six hours of purging unless it is a slow recovery well or
  - As soon as sufficient recharge water is available or up to 24 hours after purging for slow-recovery wells or wells that purge completely dry.

b) Use one pre-cleaned or disposable bailer per well.
c) Attach new nylon rope or other appropriate cord to the bailer.
d) Slowly immerse the bailer into the top of the water column to reduce agitation and splashing.
e) Fill bailer and promptly remove from well.
f) Record sample observations in field log book.

Aliquot Sample: Aliquot the sample into the containers necessary for both laboratory analysis and any further field measurements. For laboratory analysis, include initials, date and time of sample collection, sample ID, preservative and analysis required on sample container label. Place in cooler and cool to 4° Celsius (C) with wet ice.

Groundwater samples collected for total dissolved metals analyses will be field filtered prior to being placed in sample containers and properly preserved. Groundwater filtration will be performed using a peristaltic pump and a 0.45-micron in-line water filter. Disposable filters are commonly available in 0.45-micron size. Low-capacity or high-capacity cartridges are available and may be selectively used based on sample turbidity.

The filtration of groundwater samples shall be performed either directly from the pump discharge line or from laboratory-supplied intermediate containers. In either case, well purging shall be performed first. Fresh groundwater shall then be filtered directly into sample containers.

Post-Sampling Activities: Several activities need to be completed and documented once ground-water sampling has been completed. These activities include, but are not limited to:

- Ensuring that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible.
- Processing all sample paperwork, including copies provided to laboratory.
- Compiling all field data for site records.
- Verifying all analytical data processed by the analytical laboratory against field sheets and chain-of-custody to ensure all appropriate sample analyses has been returned to sampler.

TABLE 2: Pump Assisted Purging and Bailer Sampling

Purge Equipment:	Motor-driven centrifugal lift pump
Sampling Equipment:	The bailer system can be dedicated or non-dedicated. a) Bailer: pre-cleaned closed-top Teflon® or stainless steel bailer or a disposable polyethylene bailer. b) Either of the following: (1) New braided nylon or polypropylene cords, one per well (disposable); (2) Reusable lanyards (monofilament, stainless steel, or Teflon-coated) for dedicated bailer systems.
Sampling Procedure:	Before opening the well, a clean working surface shall be set up around the well head using a clean plastic sheet. Prior to opening the well, the required health and safety gear (as specified in the HASP) shall be donned. This, at a minimum, usually means wearing gloves to limit the potential for exposure to contaminants as well as reduce the potential for handling-induced contamination of sampling equipment. ***Preliminary Measurements:*** Measure the depth to water at the pre-marked well casing reference point (notch or other visible mark) and calculate the water level (water column height) and volume of water in casing. Note: Following water-level measurement, if free phase product is suspected, measure the product thickness with an interface as specified in the work plan. If measurable quantities of product are encountered do not sample and notify the Project Manager immediately. Ensure that water level meter / interface probes are probes are decontaminated after each use. If multiple wells are to be sampled, work from cleanest to most contaminated based on analytical data and/or field observations made during soil boring / well installation. ***Purge well:*** Note: If non-dedicated equipment is used for purging, at least one equipment blank (or as specified in work plan) will be collected from the decontaminated / cleaned purge equipment. Operate all petroleum fueled power sources or related equipment downwind from the sampling location. The well should not be pumped dry during low-flow purging. 1. Lower the pump / hose assembly into the top of the standing water column. Keep assembly towards top of water column so that the purging will evacuate water from the formation into the screened area of the well and up through the casing to remove the entire static volume. 2. Begin purging the water and calculate flow rate. 3. Determine the time necessary to purge one-half the well screen volume or that specified in the work plan. Take field parameters, depth to water, and flow-rate measurements every five to ten minutes (or more frequently depending on the time necessary to purge one-half the well screen volume). 4. Stop purging when necessary well volume has been removed and parameters have stabilized. 5. Containerize the purged water unless specified otherwise in the project work plan. ***Stabilize well:*** Measure and record water level until 80% static water level is achieved (well fully recharged). Measure and record field parameters until groundwater chemistry stability is achieved as specified in the project work plan. See Appendix A for reference information. ***Sampling*** 1. Sample wells: a) Within six hours of purging unless it is a slow recovery well or b) As soon as sufficient recharge water is available or up to 24 hours after purging for slow-recovery wells or wells that purge completely dry.

2. Use one pre-cleaned or disposable bailer per well.
3. Attach new nylon rope or other appropriate cord to the bailer.
4. Slowly immerse the bailer into the top of the water column to reduce agitation and splashing.
5. Fill bailer and promptly remove from well.
6. Record sample observations in field log book.

Aliquot Sample: Aliquot the sample into the containers necessary for both laboratory analysis (see Tables 4, 5, 6 and 7) and for any further field measurements. For laboratory analysis, include initials, date and time of sample collection, sample ID, preservative and analysis required on sample container label. Place in cooler and cool to 4° Celsius (C) with wet ice.

Decontamination: After sampling a well, decontaminate all reusable equipment and samplers prior to future use.

See Section 7 for field measurements.

TABLE 3: Low Flow Purge and Sample Collection

Purging and Sampling Strategy:	Low-Flow Purge Collection Method with pump
Purge and Sampling Equipment:	Dedicated or non-dedicated equipment may be used. Low-Flow Purge System includes submersible or non-submersible pump, tubing, and suspension cable.
Sampling Procedure:	***Pump Installation and Set-up***: (1) Open the well and allow water level to equilibrate before taking a water level measurement. (2) Measure the depth to water at the pre-marked well casing reference point (notch or other visible mark) and calculate the water level (water column height) and volume of water in casing. (3) Set submersible pump or pump tubing within the screen interval or slightly above screened interval of the well. (4) Place the pump inlet or submersible tubing just below the surface of the water column. (5) Set-up associated equipment (generator, compressor, tubing, etc.) ***Preliminary Measurements:*** Ensure well is fully recharged after pump / tubing installation by taking a water level measurement. Note: Following water-level measurement, if free phase product is suspected, measure the product thickness with an interface probe if and as specified in the work plan. If measurable quantities of product are encountered do not sample and notify the Project Manager immediately. ***Purge and Stabilize Well:*** Note: If non-dedicated equipment is used for purging, at least one equipment blank (or as specified in work plan) will be collected from the decontaminated / cleaned purge equipment. Operate all petroleum fueled power sources or related equipment downwind from the sampling location. The well should not be pumped dry during low-flow purging. The intent of low flow purging is to minimize drawdown. 1. Lower the pump inlet as the well is purged. 2. Calculate Flow Rate of purged groundwater (range 200 - 500 ml per minute). 3. Flow rate may be adjusted at this point but flow-rate should not exceed the recharge rate of the aquifer. Monitor by measuring the top of the water column with a water level recorder or similar device while purging. Continue to measure the water level flow-rate until stability is achieved. 4. A maximum of a 0.3 foot draw down produced by the pump is allowed. 5. Take field parameters, depth to water, and flow-rate measurements every 5–10 minutes (or more frequently depending on the time necessary to purge one-half the well screen volume). 6. Containerize the purged water unless specified otherwise in the project work plan. 7. Sampling occurs after the water level and groundwater chemistry parameters are stable as specified in this SOP or in project work plans. ***Sampling:*** 1. Reduce the flow to a low level to minimize sample disturbance, if necessary, and collect sample directly from the discharge tubing connected to the pump. Discharge tubing should not contact the inside of the sample containers. 2. Aliquot samples according to the number and analysis type as specified in the work plan and include initials, date and time of sample collection, sample ID, preservative and analysis required on sample container label. 3. Place in cooler and cool to 4° Celsius (C) with wet ice. 4. Record sample observations in field log book.

	Decontamination: After sampling, decontaminate the low-flow purge equipment prior to further use. See Section 7 for field measurements.

7. FIELD MEASUREMENTS

Unless specified otherwise in the project documents, the following measurements will be taken and evaluated for acceptability:

Parameter	**Acceptable Range for establishing stability***
Temperature	10% of reading
pH	±0.2 standard units
Conductivity	±3% of readings
Dissolved oxygen	±10% of reading
Redox potential(ORP or Eh)	±20 mV
Turbidity*	≤5 NTU or ±10% reading, whichever is greater

* Three consecutive acceptable measurements typically establish water quality.

8. FIELD RECORDS

8.1 Field Logbook

See the Field Documentation SOP, 07-DOC-00, for generic documentation items. Examples of specific groundwater sampling documentation include the following:

a. Facility name;
b. Date and time of arrival;
c. Weather conditions, including ambient air temperature and/or miscellaneous observations;
d. Location;
e. Well designation;
f. Well sequence number;
g. Static water level;
h. Total depth of well;
i. Depth to water;
j. Casing diameter;
k. Well volume or one-half well screen volume;
l. Method of purging;
m. Start time of purging;
n. Total volume of water evacuated from well;
o. Evacuation completion time;
p. Sampling strategy (bailer manual, bailer automated, low-flow);
q. Flow rate recorded (if applicable);
r. Field equipment calibration check;

s. Water quality measurements;
t. Water level at time of sample collection;
u. Date and time sample collected;
v. Sample sequence number;
w. Sample Equipment ID;
x. Other pertinent observations of water samples (color, turbidity, odor, etc.);
y. Fractions sampled and preservation method;
z. Signature of sampler(s) and date; and
aa. Miscellaneous information, i.e. well was purged dry prior to taking 3 evacuation volumes.

8.2 Chain-of-Custody

Completed chain-of-custody (COC) forms are maintained for all samples. A sample COC form is included as Attachment A. The original form is sent to the laboratory with the samples and signed by the lab upon receipt. Original completed COC forms are returned to KEMRON with the analytical report. A copy of the COC will be retained by the field crew and kept with field records.

9. DECONTAMINATION

All equipment taken to the field will be clean. Decontamination of equipment is performed:

- During a sampling event for multiple uses of equipment,
- At the conclusion of equipment use at the site, or
- If visual evidence indicates a need for decontamination at the onset of equipment use. This does not apply for dedicated equipment.

The following procedures, or those specified in the site-specific documents, are completed for reusable non-dedicated equipment:

1. Hand wash, or flush / pump through automatic samplers/equipment, with a non-phosphate laboratory detergent dissolved in tap water;
2. Rinse with tap water;
3. Rinse thoroughly with deionized water;
4. Allow to air dry;
5. Wrap in aluminum foil and a plastic bag, if needed, and store in a clean, dry area;

Decontamination solvent such as isopropanol, acetone or hexane may be used for equipment exposed to high levels of organics (e.g., NAPL). Use of specific decontamination solvents should be addressed in project-specific planning documents and the waste solvents managed and disposed in accordance with applicable regulations.

10. SHIPPING

Equipment decontamination chemicals may need to be shipped to the site and samples may need to be shipped to the laboratory. All shipping is completed in accordance with the current federal and international regulations (DOT, EPA, IATA). Shipping stipulations are to be included in the project documents, but should you have any questions regarding shipping of any materials to and from the site, contact the authorized shipping representative in your home office.

11. ASSOCIATED SOPs

Field Log Book 07-DOC-00
Well Installation 12-MWC-00

12. REFERENCES

USEPA, Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, EPA 542-S-02-001, May 2002.

USEPA, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedure, EPA 540-S-95-504, April 1996.

USEPA, RCRA Groundwater Monitoring, Draft Technical Guidance, November 1992.

USEPA, Potential Source of Error in Groundwater Sampling at Hazardous Waste Sites, EPA 540-S-92-019, August 1992.

KEMRON ENVIRONMENTAL SERVICES

ATTACHMENT A – EXAMPLE CHAIN-OF-CUSTODY

COC No. A 39472

109 Starlite Park
Marietta, OH 45750

KEMRON ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name:	
Project Contact:	Contact Phone #:
Turn Around Requirements:	Location:
Project #:	Project Name:
Sampler (print):	Signature:

Program
- ☐ NPDES
- ☐ RCRA
- ☐ RCRA
- ☐ [illegible]
- ☐ Other ______

ADDITIONAL REQUIREMENTS

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold																

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp. in °C	Remarks:

*Homogenize all composite samples prior to analysis

Page ______ of ______

ATTACHMENT B – EXAMPLE GROUNDWATER SAMPLE COLLECTION FORM

Well Number ____________________ Project Name:

Sample No. __________________ Project Number:

Date ______________ Collectors:

Well Information

Monument Condition ☐Good ☐Needs Repair ______________________________

Well Cap Condition ☐Good ☐Locked ☐Replaced ☐Needs Replacement

Elevation Mark ☐ Yes ☐ Added ☐other

Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☐Other

☐Odor Comments ____

Purge Data

Total Well Depth _______ ft ☐ Clean Bottom ☐Muddy Bottom ☐Not Measured

Depth to Water _______ ft

Casing Volume _______ ft (H20) X _______ gpf = _____ X 3 = ________ gallons

3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Tubing: Total volume purged ________

Sample Intake Depth ____________ Purge Rate _______

Purge Start Time _______ Purge Stop Time _______ Sample Rate _______

Field Parameters

Time	Gallons	pH	Turbidity (NTU)	Temperature (C)	Conductivity (mS/cm)	D.O. (mg/L)	Comments

Sampling Device

Filter Type: Size:

Sample Containers Collection Time__________

Tag No.	Type		Preservative	Analytical Method	QA Remarks
	☐Amber	☐Poly			
	☐Amber	☐Poly			
	☐Amber	☐Poly			
	☐Amber	☐Poly			
	☐Amber	☐Poly			
	☐Amber	☐Poly			
	☐Amber	☐Poly			
	☐Amber	☐Poly			
	☐Amber	☐Poly			

KEMRON
ENVIRONMENTAL SERVICES

Document Control #: 12-SSP-01

STANDARD OPERATING PROCEDURE FOR SOIL SAMPLING IN THE FIELD

Issue Date: November 8, 2004

Revision 01
Last Review/Implementation Date: October 11, 2010

Approved by:

Lou Ehrhard, Corporate Quality Assurance Manager — 10/11/2010 Date

John Dwyer, Executive Vice President — 10/11/2010 Date

TABLE OF CONTENTS

1. PURPOSE

The objectives of soil sampling are to ensure that valid and representative samples are collected that meet the requirements of the project, and to prevent deterioration and contamination of the samples before laboratory analysis. By complying with procedures specified in this Standard Operating Procedure (SOP), KEMRON will ensure that the following are successfully completed:

- Proper excavation.
- Proper sampling.
- Prevention of contamination or cross-contamination of soil samples during collection. containerization, transit and storage.
- Obtain and record accurate and complete sampling data.
- Preparation of complete and correct sample labels.
- Preparation and maintenance of sample chain-of-custody.

2. SCOPE

This procedure provides technical guidance on soil sampling including decontamination procedures, types, and uses of sampling equipment. This SOP applies to KEMRON personnel and subcontractors collecting soil samples for KEMRON projects. Client, federal, or state requirements, or project-specific requirements may dictate specific types of equipment or procedures to be used when applying this SOP to a particular project. Deviations from this SOP to accommodate site-specific requirements shall be documented in project planning documents and approved by the KEMRON Project Manager and Project Quality Assurance (QA) Manager, if applicable, prior to the performance of work.

3. RESPONSIBILITIES

Project Manager Responsibilities
The KEMRON Project Manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOP and the project-specific work plan. The KEMRON Project Manager ensures all field staff have reviewed and signed off on this SOP prior to beginning field work. A sign-off sheet covering all SOPs related to the project will be prepared and filed with project documents.

Field Staff Responsibilities
The KEMRON field staff prepares, organizes, and inspects all equipment required for the sampling event prior to the initiation of sampling activities. The field sampler and shipper are responsible for initiating, maintaining, and transferring chain-of-custody. Upon completion of the sampling event, the field staff returns all equipment to the designated storage area ensuring that the equipment is decontaminated and in a condition ready for reuse. KEMRON field staff are required to follow procedures specified in this SOP, or approved project-specific SOP, prior to

initiating the sampling event. Field staff are required to sign off that they have read and understand this SOP prior to beginning field work.

4. DEFINITIONS

bgs: - below ground surface

Dressing Soil Surfaces - Dressing soil surfaces includes removing the exposed soil surface prior to sampling using a stainless steel shovel, spatula, knife, or spoon. The depth of soil removed depends on the technique used to expose the soil (excavation with a backhoe requires more removal than excavation with a shovel).

Homogenization - The process of mixing samples in order to minimize any bias of sample representativeness introduced by the natural stratification of constituents within the sample. To homogenize a sample, place each grab or core material into a single mixing bowl (made of suitable material i.e. stainless steel), remove any large objects such as sticks, leaves or stones, etc. and stir thoroughly with a spoon to homogenize. Scrape the soil from the sides, corners, and bottom of the pan; roll to the middle of the pan; and complete a final mixing in the center of the pan. Flatten the sample, if needed, quarter the sample, and move to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled back to the center of the container and the entire sample mixed again. Aliquot as appropriate.

Sample Compositing - Discrete samples are taken and then proportionally combined into one sample container. Composite samples are generally used to estimate the average concentration of the individual samples that make up the composite.

5. PLANNING

The Project Manager provides any project specific information in written instructions for the sampling crew. Written instructions can be as simple as a sampling requirements report or as detailed as a Sampling and Analysis Plan (SAP). Items in written sampling instructions may include a sampling grid, depths to sample, analyses to sample for, etc.

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific SAP and Quality Assurance Project Plan (QAPP). Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements typically suggest the collection of a sufficient quantity of quality control (QC) samples such as field duplicate, equipment and/or field blank, and matrix spike/matrix spike duplicate (MS/MSD) samples. These requirements should be outlined in the SAP/QAPP.

Information regarding the sample containers, preservation techniques and holding times for soil samples will be described in the project specific SAP/QAPP.

Soil sampling may involve chemical hazards associated with the materials being sampled. Adequate health and safety measures must be taken to protect project sampling personnel from potential chemical exposures or other hazards. These measures must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project health and safety officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed.

6. EXCAVATION AND SAMPLE COLLECTION EQUIPMENT AND PROCEDURES

The tables in this section provide a description of equipment and sampling procedures for different soil sampling methods. The project work plan will specify the method and any site-specific requirements. Once the soil is sampled, the sample will be aliquoted in the following sequence or as stated in the project-specific planning documents: Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), Pesticides, Herbicides, Polychlorinated Biphenyls (PCBs), and Metals.

Soil sampling equipment and supplies can include the following:

- Maps/plot plan
- Safety equipment, as specified in the site-specific HASP (PPE, etc.)
- Survey equipment or global positioning system (GPS) to locate sampling points
- Tape measure
- Survey stakes or flags
- Camera (extra batteries, extra memory chip)
- Stainless steel, plastic, or other appropriate homogenization bucket, bowl or pan - tools plated with chrome or other materials should not be used
- Sample containers
- Ziploc plastic bags
- Logbook
- Labels
- Chain-of-Custody records and custody seals
- Field data sheets and sample labels
- Cooler(s) with thermometer for checking temperature
- Ice
- Vermiculite
- Decontamination supplies/equipment
- Canvas or plastic sheet
- Spade or shovel
- Spatula
- Scoop
- Plastic or stainless steel spoons
- Trowel(s)
- Continuous flight (screw) auger
- Bucket auger
- Post hole auger

- Extension rods
- T-handle
- Portable electronic scale
- Sampling trier
- Thin wall tube sampler
- Split spoons
- Vehimeyer soil sampler outfit
- Tubes
- Points
- Drive head
- Drop hammer
- Puller jack and grip
- Backhoe

Soil VOC samples for site investigations conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or the Resource Conservation and Recovery Act (RCRA), as well as some other state or federal regulatory programs, may require that collection and analysis in accordance with USEPA Method 5035. This method specifies the use of a special sampling device. USEPA instituted this type of sampling based upon studies that indicated this purge and trap method of sampling and analysis more accurately identified the types and concentrations of VOCs in soils than prior methods. USEPA and some states determined that prior methods introduced error based upon evaporative loss of VOCs that Method 5035 is believed to be eliminated.

When implementing Method 5035 sampling and analysis, an Encore™® or Terracore™® (or equivalent and EPA-approved) sampling device is required. The samplers are attached to a T-handle that serves to assist in pushing the sampler into the soil. Three (3) samplers are usually required to be used to complete a single sample; this provides the laboratory one sample for high contaminant analysis and two samples for low level analysis. The samples are either preserved by freezing upon receipt at the laboratory, or preserved within 48 hours with the appropriate preservative (methanol or sodium bisulfate). Please note that some regulatory programs do not accept freezing of samples as an adequate means of preservation. If freezing is not allowed, sample preparation in the laboratory must be performed within 48 hours of sample collection; therefore, advance coordination with the analytical laboratory regarding sample collection, delivery and preparation is critical to a successful sampling and analysis program.

The sampler must review the manufacturer's instructions that accompany the sampling device prior to use, and must be trained by KEMRON personnel experienced in use of the sampling device prior to conduct of sampling.

Additionally, hard clays and gravels may not be able to be sampled with Encore™® or Terracore™® samplers; the Project Manager should assess the site geology to determine feasibility of sampling protocol. The Project Manager also should be aware that EnCore samplers typically have a higher associated cost than Terracores.

Use of Terracore Samplers with Pre-prepared Vials:
An undisturbed soil sample is obtained by pushing the barrel of the coring tool into a freshly exposed surface and removing the corer once filed. An approximate five (5) gram weight sample is obtained for each Terracore™®, with sample weights determined in the field using a portable electronic scale. The sample is extruded into laboratory prepared, pre-tared and labeled 40 ml vials with a stir bar. The laboratory adds the necessary preservative upon log-in. A separate sample must be collected for soil moisture content measurement, using a wide-mouth glass jar; size of the sample is not critical.

Use of EnCore™® Samplers:
The EnCore™® sampler serves as the sample shipping container. An undisturbed sample is obtained by pushing the barrel of the coring tool into the freshly exposed surface and removing the corer once filled. The exterior of the barrel is quickly wiped with a clean disposable towel to ensure a tight seal. An airtight cap is then attached to create a complete sample package. The sample is labeled and inserted into a sealable (e.g., zip lock) pouch, immediately cooled to 4 ± 2°C, and prepared for shipment to the analytical laboratory.

TABLE 1: SOIL SAMPLING WITH SPOONS, SHOVELS, POST-HOLE DIGGERS, BOWLS

Item	Description
Soil Level Identification:	Surface Soils
Soil Depth:	Based on project specific requirements, typically in range of 0 to 12" bgs
Equipment:	Shovel, post-hole digger, stainless steel spoon, stainless steel bowl
Excavation Procedure:	Use the spoon, shovel or post-hole digger as intended.
Sampling Procedure:	***Preparation:*** 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required. 2. Obtain necessary sampling and monitoring equipment. 3. Decontaminate or pre-clean equipment, and ensure that it is in working order. 4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate. 5. Perform a general site survey prior to site entry in accordance with the site specific HASP. 6. Use stakes, flagging, or cones to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. Underground utility clearance should be performed in accordance with KEMRON's utility clearance SOP 12-UTL-00, and utility clearance should always be confirmed before beginning work. ***Sampling:*** 1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade. 2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade. 3. If VOC analysis is to be performed via Method 5035 (Encore or equivalent) sampling, the sample is to be collected directly from the soil. Otherwise, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly. 4. Place samples in cooler and cool to 4° Celsius (C) with wet ice. 5. Record sample observations in field log book. ***Post-Sampling Activities:*** Several activities need to be completed and documented once soil sampling has been completed. These activities include, but are not limited to: • Ensuring that all field equipment has been decontaminated and returned to

	proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible. • Processing all sample paperwork, including copies provided to laboratory. • Compiling all field data for site records. • Verifying all analytical data processed by the analytical laboratory against field sheets and chain-of-custody to ensure all appropriate sample analyses has been returned to sampler.

TABLE 2: HAND-AUGER OR THIN-WALL TUBE SAMPLER

Item	Description
Soil Level Identification:	• Surface Soils • Shallow Subsurface Soils
Soil Depth:	• Based on project specific requirements, typically in range of 0 to 12" bgs • 12 inches bgs to the depth that manual methods become impractical
Equipment:	Stainless steel hand auger, stainless steel spoon, stainless steel bowl
Excavation Procedure:	Typically, four ()-inch auger buckets with cutting heads are pushed and twisted into the ground and removed as the auger bucket is filled. The auger holes are advanced one bucket at a time. When the depth of a sampling interval has been reached, one auger bucket is used to advance the auger hole to the first desired sampling depth.
Sampling Procedure	***Preparation:*** 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required. 2. Obtain necessary sampling and monitoring equipment. 3. Decontaminate or pre-clean equipment, and ensure that it is in working order. 4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate. 5. Perform a general site survey prior to site entry in accordance with the site specific HASP. 6. Use stakes, flagging, or cones to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. Underground utility clearance should be performed in accordance with KEMRON's utility clearance SOP 12-UTL-00, and utility clearance should always be confirmed before beginning work. ***Sampling:*** This system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle (Figure 1, Appendix A). The auger is used to bore a hole to a desired sampling depth and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler. Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and cannot be used below a depth of approximately three feet. The following procedure is used for collecting soil samples with the auger: 1. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod. 2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an

area approximately six inches in radius around the drilling location.

3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
4. After reaching the desired depth, slowly and carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole and proceed to Step 10.
5. Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
7. Remove the tube sampler, and unscrew the drill rods.
8. Remove the cutting tip, and the core from the device.
9. Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.
10. If VOCs analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. If Method 5035 (Encore or equivalent) sampling is required, the sample is to be collected directly from the core. Otherwise, place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.
11. Place samples in cooler and cool to 4° Celsius (C) with wet ice.
12. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.
13. Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.
14. Record sample observations in field log book.

Post-Sampling Activities:

Several activities need to be completed and documented once soil sampling has been completed. These activities include, but are not limited to:

- Ensuring that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible.
- Processing all sample paperwork, including copies provided to laboratory.
- Compiling all field data for site records.

	• Verifying all analytical data processed by the analytical laboratory against field sheets and chain-of-custody to ensure all appropriate sample analyses has been returned to sampler.

TABLE 3: SHELBY OR "PUSH TUBE"

Item	Description
Soil Level Identification:	• Surface Soils • Shallow Subsurface Soils
Soil Depth:	• Based on project specific requirements, typically in range of 0 to 12" bgs • 12 inches bgs to depth that manual methods become impractical
Excavation Procedure:	Drive the tube into the soil with a drill rig, if necessary.
Sampling Procedure:	***Preparation:*** 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required. 2. Obtain necessary sampling and monitoring equipment. 3. Decontaminate or pre-clean equipment, and ensure that it is in working order. 4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate. 5. Perform a general site survey prior to site entry in accordance with the site specific HASP. 6. Use stakes, flagging, or cones to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. Underground utility clearance should be performed in accordance with KEMRON's utility clearance SOP 12-UTL-00, and utility clearance should always be confirmed before beginning work. ***Sampling:*** 1. Drill to first sampling depth, as described in the project planning documents. 2. Place decontaminated Shelby tube sampler on center rods. 3. Drive Shelby tube sampler with the push head of the drill rig, as described in ASTM Method D1587. Retrieve the sampling tube and remove the disturbed material from the top of the tube. In addition, remove 1 inch of soil from the base of the tube. Place an impervious disk at both ends of the tube seal with a wax plug prior to shipment to the laboratory. 4. If Shelby tubes are to be extruded in the field for composite sampling, the driller will use a hydraulic extruder to obtain the sample. Samples will then be composited, as necessary, for analysis. 5. Screen sampler with PID (if required). 6. Label and manage sample containers in accordance with the site-specific SAP section for shipping and handling of samples. The sample tube should be packed in Styrofoam™ plugs or other cushioning material to prevent disturbance of the sample while en route to the geotechnical laboratory for analyses. 7. Record sample observations in field log book. ***Post-Sampling Activities:*** Several activities need to be completed and documented once soil sampling has been completed. These activities include, but are not limited to: • Ensuring that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of

	individual responsible. • Processing all sample paperwork, including copies provided to laboratory. • Compiling all field data for site records. • Verifying all analytical data processed by the analytical laboratory against field sheets and chain-of-custody to ensure all appropriate sample analyses has been returned to sampler.

TABLE 4: BACKHOE TRENCH OR BUCKET SAMPLING

Item	Description
Soil Level Identification:	• Surface Soils • Shallow Subsurface Soils
Soil Depth:	• Based on project specific requirements, typically in range of 0 to 12" bgs • 12 inches bgs – depth manual methods become impractical or the depth that a backhoe can reach
Excavation Procedure:	Backhoe operator is instructed what area to excavate.
Sampling Procedure:	***Preparation:*** 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required. 2. Obtain necessary sampling and monitoring equipment. 3. Decontaminate or pre-clean equipment, and ensure that it is in working order. 4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate. 5. Perform a general site survey prior to site entry in accordance with the site specific HASP. 6. Use stakes, flagging, or cones to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. Underground utility clearance should be performed in accordance with KEMRON's utility clearance SOP 12-UTL-00, and utility clearance should always be confirmed before beginning work. ***Sampling:*** A backhoe can be used to remove sections of soil when detailed examination of soil characteristics is required. This is probably the most expensive sampling method because of the relatively high cost of backhoe operation. The following procedures are used for collecting soil samples from test pits or trenches: 1. Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of overhead and buried utilities. 2. Review the site specific HASP and ensure that all safety precautions including appropriate monitoring equipment are installed as required. 3. Using the backhoe, excavate a trench approximately three feet wide and approximately one foot deep below the cleared sampling location. Place excavated soils on plastic sheets. Trenches greater than four feet deep must be sloped or protected by a shoring system, as required by OSHA regulations. 4. A shovel is used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done. 5. Samples are taken using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket. KEMRON employees are not to enter trenches for the purposes of sample collection unless done so under specific health & safety requirements, work plans or procedures.

6. If VOC analyses are required, the Encore or equivalent sampling device is to be used to collect the sample. Otherwise, transfer the sample into an appropriate, labeled sample container with a stainless steel spoon or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.
7. Place samples in cooler and cool to 4° Celsius (C) with wet ice.
8. Abandon the pit or excavation according to applicable state regulations. Generally, shallow excavations can simply be backfilled with the removed soil material.
9. Record sample observations in field log book.

Post-Sampling Activities:
Several activities need to be completed and documented once soil sampling has been completed. These activities include, but are not limited to:

- Ensuring that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible.
- Processing all sample paperwork, including copies provided to laboratory.
- Compiling all field data for site records.
- Verifying all analytical data processed by the analytical laboratory against field sheets and chain-of-custody to ensure all appropriate sample analyses has been returned to sampler.

TABLE 5: DRILL RIGS WITH SPLIT SPOON (BARREL) SAMPLER

Item	Description
Soil Level Identification:	Deep Subsurface Soils
Soil Depth:	> 20 feet
Excavation Procedure:	***Split-Spoon – Hammer driven:*** • Drive the split-spoon sampler either inside a hollow-stem auger or inside an open borehole after rotary drilling equipment has been temporarily removed. • Record the number of blows required to drive the spoon for each six-inch interval. • Remove the spoon. ***Continuous split-spoon:*** While drilling, advance the hollow-stem auger containing the split-spoon.
Sampling Procedure:	***Preparation:*** 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required. 2. Obtain necessary sampling and monitoring equipment. 3. Decontaminate or pre-clean equipment, and ensure that it is in working order. 4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate. 5. Perform a general site survey prior to site entry in accordance with the site specific HASP. 6. Use stakes, flagging, or cones to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. Underground utility clearance should be performed in accordance with KEMRON's utility clearance SOP 12-UTL-00, and utility clearance should always be confirmed before beginning work. ***Sampling:*** Split spoon sampling is generally used to collect undisturbed soil cores of 18 or 24inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augered hole and the core extracted. When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D1586-98, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils". The following procedures are used for collecting soil samples with a split spoon: 1. Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top. 2. Place the sampler in a perpendicular position on the sample material. 3. Using a well ring, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result. 4. Record in the site log book or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth. 5. Withdraw the sampler, and open by unscrewing the bit and head and splitting

the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2 and 3 ½ inch diameters. A larger barrel may be necessary to obtain the required sample volume.

6. Without disturbing the core, use the Encore or equivalent to collect the soil sample for VOC analysis. Otherwise, transfer portion for VOC analyses to appropriate labeled sample container(s) and seal tightly.
7. Place the remaining soil into a stainless steel bowl, homogenize, and transfer portions for remaining analyses to appropriate sample container(s) and seal tightly.
8. Place in cooler and cool to 4° Celsius (C) with wet ice.
9. If another sample is to be collected in the same hole, but at a greater depth, reattach a (decontaminated / clean) split spoon sampler to the drill rod, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.
10. Abandon the hole according to applicable state regulations or install monitoring well if applicable in accordance with the site work plan and KEMRON SOP 12-MWC-00.

Post-Sampling Activities:

Several activities need to be completed and documented once soil sampling has been completed. These activities include, but are not limited to:

- Ensuring that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible.
- Processing all sample paperwork, including copies provided to laboratory.
- Compiling all field data for site records.
- Verifying all analytical data processed by the analytical laboratory against field sheets and chain-of-custody to ensure all appropriate sample analyses has been returned to sampler.

7. FIELD RECORDS

7.1 Field Logbook

See the Field Documentation SOP, 07-DOC-00, for generic documentation items. Examples of specific soil sampling documentation include the following:

a. Site Name;
b. Date and time of arrival;
c. Weather conditions, including ambient air temperature and/or miscellaneous observations;
d. Location;
e. Date and time sampling;
f. Sample location and boring ID;
g. Sample depth;
h. Sample sequence number;
i. Sample Equipment ID;
j. Method of sampling;
k. Field parameters (pH, conductivity, and temperature);
l. Fractions sampled and preservation method(s);
m. Signature of Sampler and Date;
n. Physical characteristics, to include the general soil type (sand, silt, clay, and organic/other matter such as wood chips, as determined using the Unified Soil Classification System (USCS)), approximate grain size (fine, medium, coarse), presence of observable biota, odor, color, layers, depth of layer changes;
o. Pertinent field observations and comments;
p. Site drawing showing sample locations, dimensions, and prominent features.

7.2 Chain-of-Custody

Completed chain-of-custody (COC) forms must be maintained for all samples. Sample labels should be checked against the completed COC for accuracy. An example COC form is included as Attachment A. The original form will be sent to the laboratory with the samples and signed by the lab upon receipt. Original completed COC forms will be returned to KEMRON with the analytical report. A copy of the COC will be retained by the field crew (sampler) and kept with field records.

8. DECONTAMINATION

All reusable equipment taken to the field will be clean. The following procedures, or that specified in the site-specific documents, are completed during a sampling event for multiple uses of equipment, at the conclusion of equipment use at the site and if visual evidence indicates a need at the onset of equipment use.

1. Hand wash, or flush/pump through automatic samplers/equipment, with a non-phosphate laboratory detergent dissolved in tap water;

2. Rinse with tap water;
3. Rinse thoroughly with deionized water;
4. Allow to air dry;
5. Wrap in aluminum foil and a plastic bag, if needed, and store in a clean, dry area.

Decontamination solvent such as isopropanol, acetone or hexane may be used for equipment exposed to high levels of organics (e.g., NAPL). Use of specific decontamination solvents should be addressed in project-specific planning documents and the waste solvents managed and disposed in accordance with applicable regulations.

9. SAMPLE SHIPMENT

Equipment decontamination chemicals may need to be shipped to the site and samples may need to be shipped to the laboratory. All shipping is completed in accordance with the current federal and international regulations (DOT, EPA, and IATA). Shipping stipulations are to be included in the project documents, but should you have any questions regarding shipping of any materials to and from the site, contact the authorized shipping representative in your home office.

10. ASSOCIATED SOPs

Field Log Book 07-DOC-00

Well Installation 12-MWC-00

Utility Clearance 12-UTL-00

11. REFERENCES

ASTM D 1586-98, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils"

USEPA Environmental Response Team, Feb 2000. Standard Operating Procedure (SOP) #2012, Soil Sampling.

USEPA, July 2002. Draft Revision 1, Method 5035A, Appendix A, The Collection and Preservation of Aqueous and Solid Samples for Volatile Organic Compound (VOC) Analysis.

KEMRON ENVIRONMENTAL SERVICES

ATTACHMENT A – EXAMPLE CHAIN OF CUSTODY FORM

COC No. A 39472

109 Starlite Park
Marietta, OH 45750

KEMRON ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name:	
Project Contact:	Contact Phone #:
Turn Around Requirements:	Location:
Project #:	Project Name:
Sampler (print):	Signature:

[illegible]
- [ ] [illegible]
- [ ] [illegible]
- [ ] [illegible]
- [ ] [illegible]
- [ ] Other ______

ADDITIONAL REQUIREMENTS

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold														ADDITIONAL REQUIREMENTS

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:

*Homogenize all composite samples prior to analysis

Page ______ of ______